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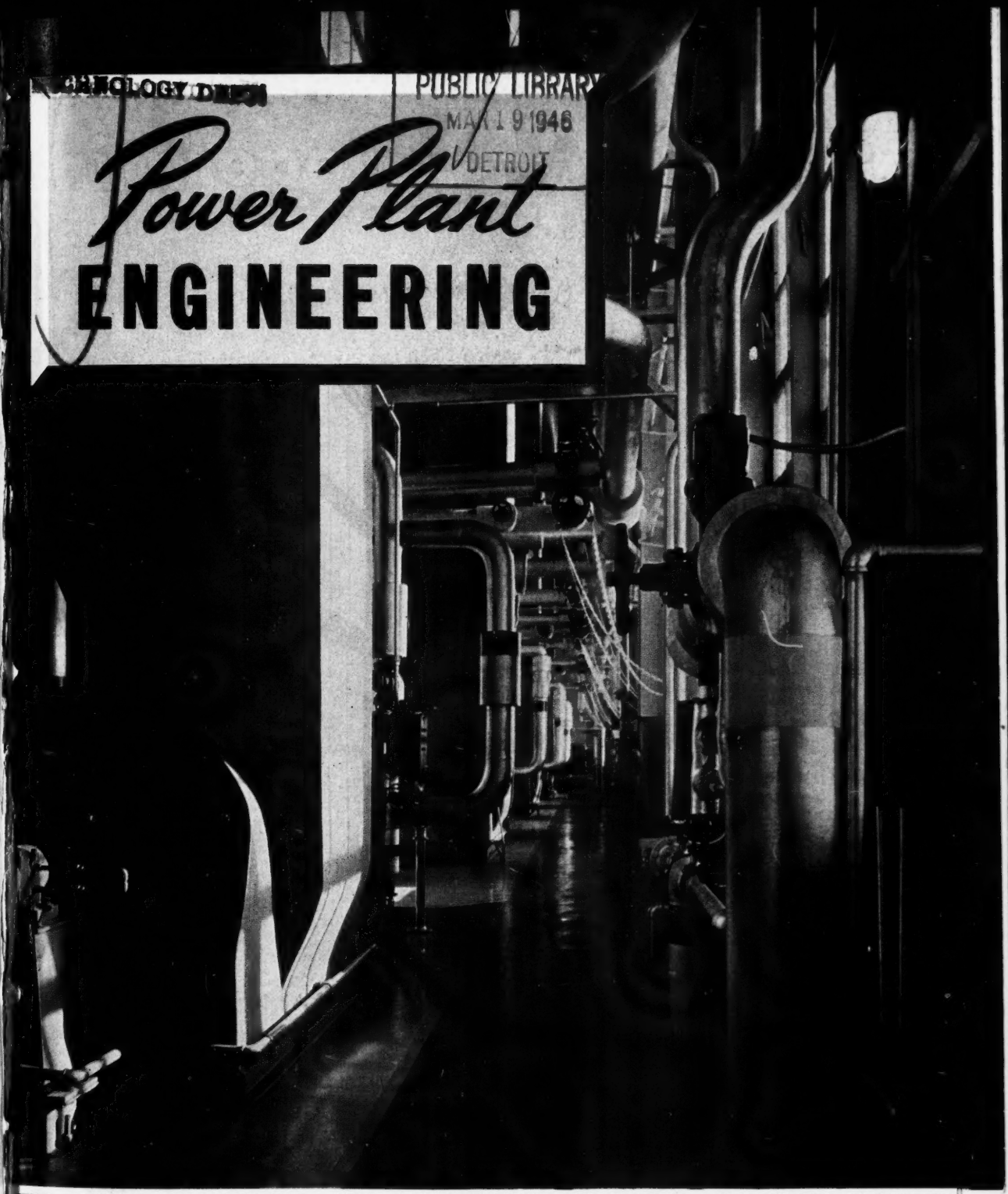

THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

MARCH • 1946

Features

REPAIRS TO TURBINE FOLLOWING HYDROGEN EXPLOSION • TWO NEW POWER PLANTS FOR SEAGRAM • MOTOR DRIVEN AUXILIARIES • CONTINUOUS BLOWDOWN • PRIMING OF CENTRIFUGAL PUMPS • ATOMICS • • • CONTENTS PAGE 5

Corrosion-killers wherever you
ELLIOTT Deaerating

ELLIOTT
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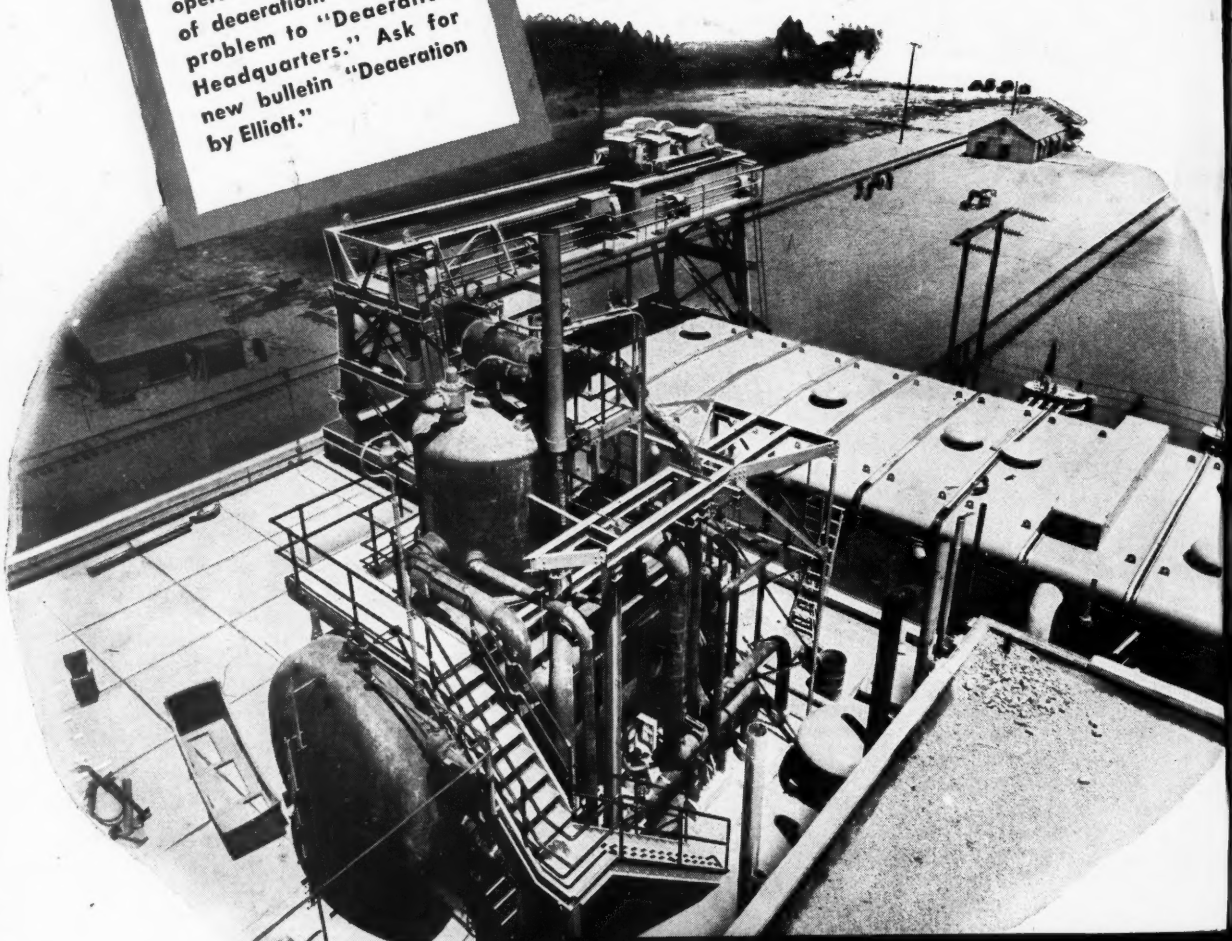
DEAERATION

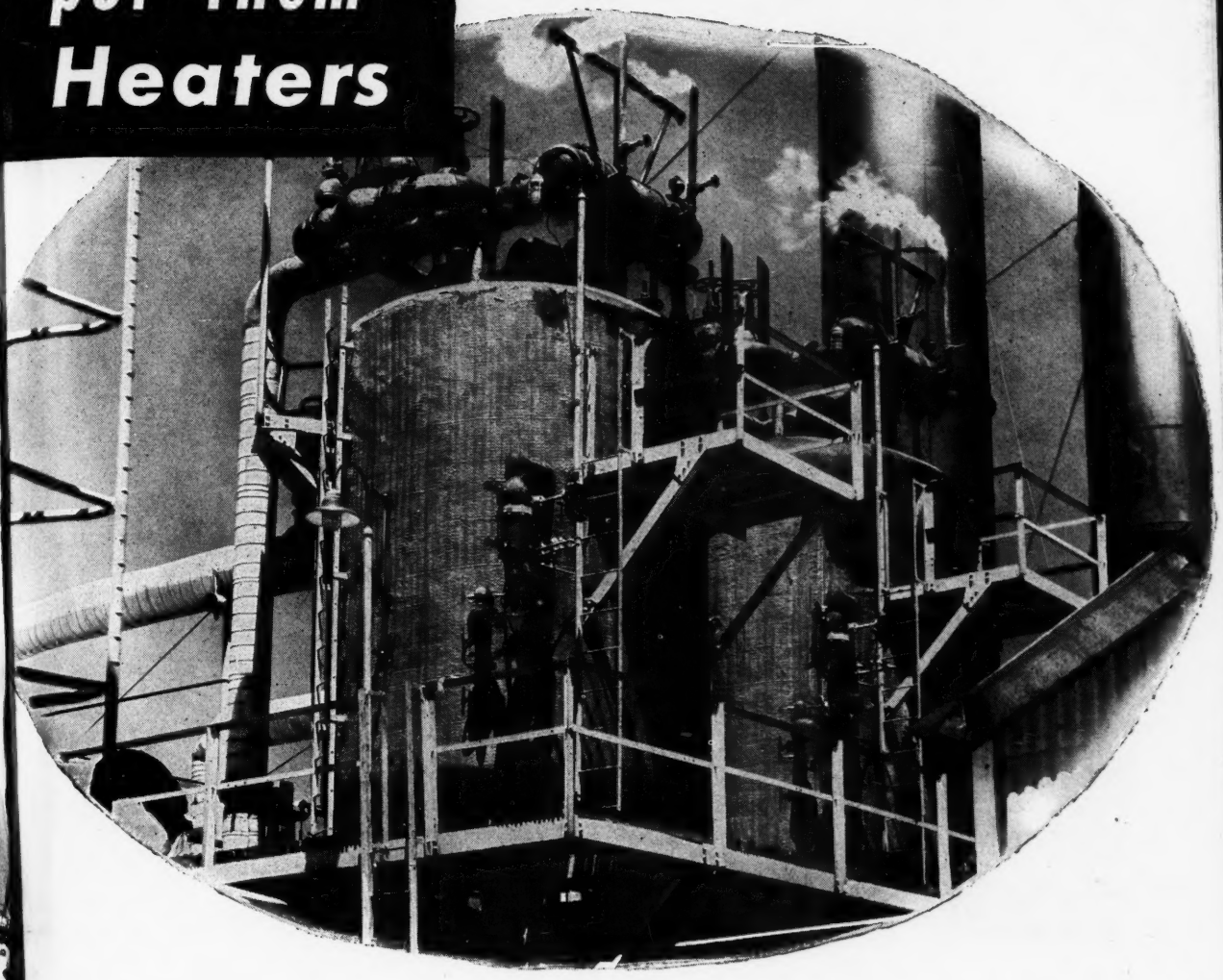
and Elliott engineers are equipped to supply authoritative information and cooperation in any question of deaeration. Bring your problem to "Deaeration Headquarters." Ask for new bulletin "Deaeration by Elliott."

Installed indoors or out, afloat or ashore, they protect boilers, turbines, piping, by removing corrosion-causing gases from water. The photo below shows a representative outdoor installation—an Elliott deaerating feedwater heater on the roof of the Harvey Couch Station, Arkansas Power and Light Company. This unit is rated 300,000 lb per hr, with maximum capacity of 400,000 lb per hr, and is mounted on a 125,000 lb capacity storage tank. It operates constantly, an unsleeping guard against the ever-present enemy, corrosion.



ELLIOTT

put them Heaters



ANOTHER OUTDOOR ELLIOTT DEAERATING FEEDWATER HEATER INSTALLATION is in the Butadiene Plant of Phillips Petroleum Company, Borger, Texas. Two Elliott 453,000-lb-per-hr deaerating heaters will shortly be joined by a third similar Elliott unit to take care of plant expansion. These heaters handle cold zeolite treated water, deaerating to commercial zero oxygen, a tough assignment. Elliott turbines, blowers, barometric and surface condensers also serve the Borger plant.

N-987

Company *Deaerator and Heater Dept.*, JEANNETTE, PA.

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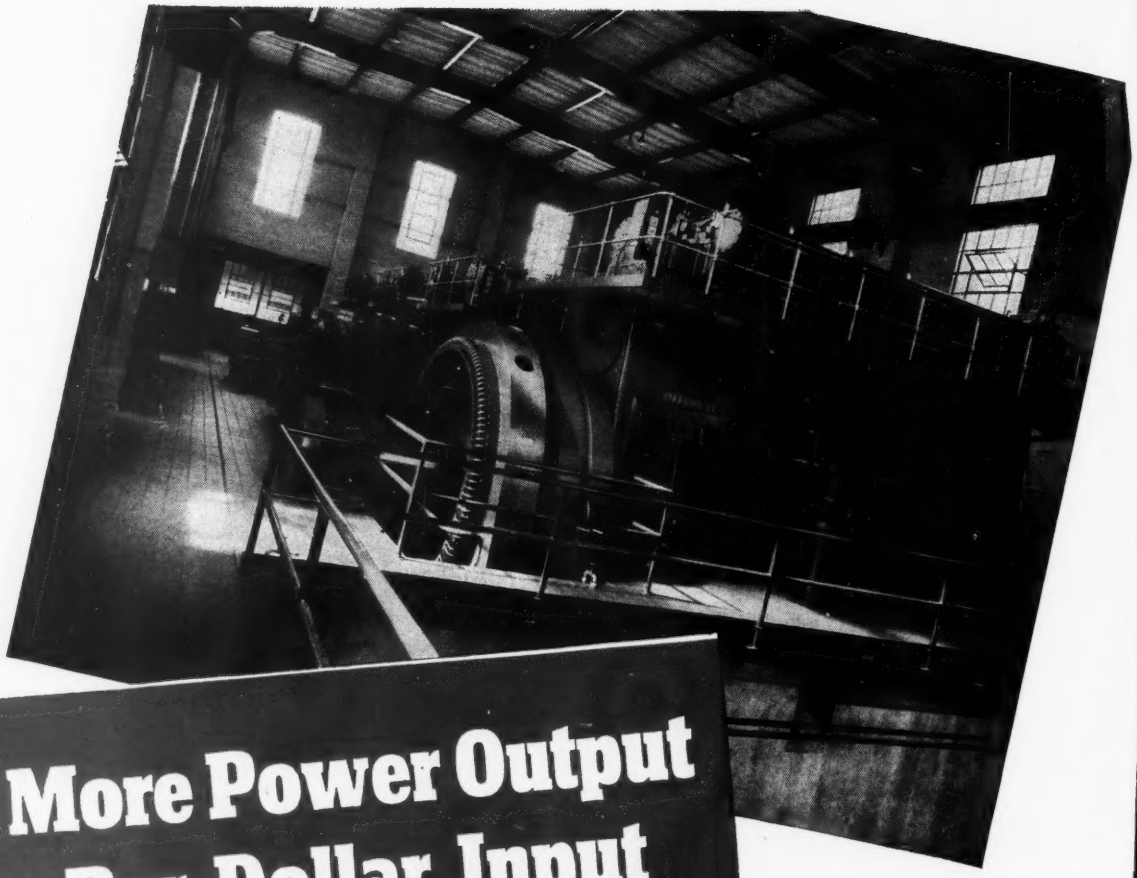

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ABC

Power Plant ENGINEERING

March, 1946

VOLUME 50—NUMBER 3

Cover: A view back of the boilers at the power plant of the Quonset Point Naval Air Station at Quonset Point, R. I. This station was described in the June, 1945, issue of Power Plant Engineering

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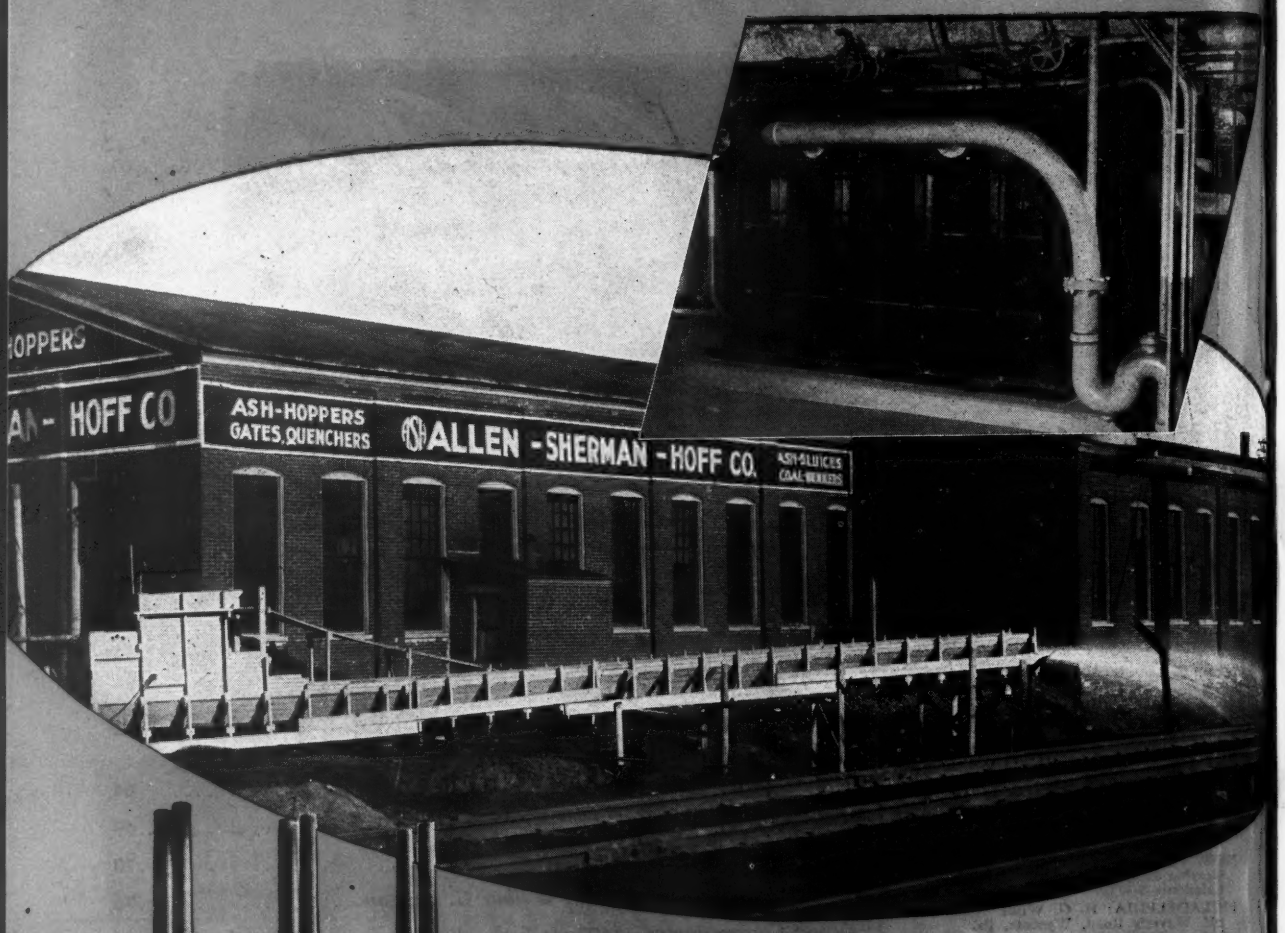

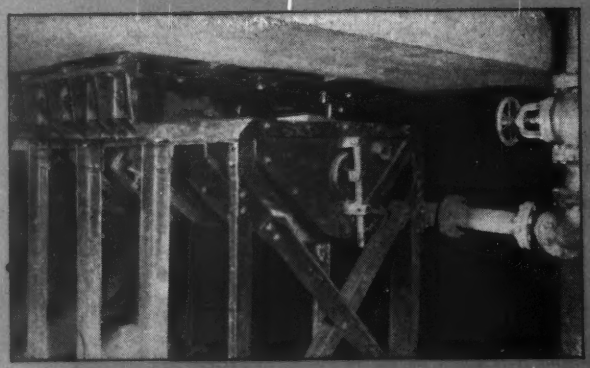

HYDROJET *Pioneering*

The rapid increase in size of central stations in the middle 1920's made it obvious that the resultant huge daily ash tonnage could not be economically handled by dumping into cars or trucks. Something much faster was urgently needed, so with the co-operation of some of the leading engineers of those days, we pioneered the Hydrojet System. A picture of our experimental Hydrojet, built of wood and erected outside our plant, appears in the oval above. With this we learned some things about feeding ashes into the horizontal sluiceway, sluiceway design and water velocities. However, the ways of a pioneer are not easy. We had many headaches and heartaches, but with the assistance of our engineering friends, who on reading this will recognize this tribute to them, we succeeded in perfecting the Hydrojet. One of our first installations is pictured at the left. Note that the sluiceway then was V-shaped; now it is half round. A modern continuous slag tap Hydroseal is pictured in the upper right. Our catalog No. 639 shows the modern Hydrojet for every type of furnace, and also shows what 20 years of pioneering have produced in cleanliness, speed and economy.

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Front Lines

REMOVAL OF 13,000,000 KW of Germany's electric generating capacity, about 60 per cent of the total installed, leaving about 9,000,000 kw, is one of five important steps to be advocated to the Allied Control Council as part of the program for German disarmament. A report prepared by a committee of the OWU last spring emphasizes that strict control of German power would be very effective if combined with other controls over industry, but not very effective if those other controls are not enforced. For example, it is impossible, first of all, to determine how much power capacity should be left the Germans until a precise determination can be made of how much industry will be left. Among other things, no synthetic oil or synthetic rubber manufacturing capacity are to be left, under other provisions of the overall control program. Thus the entire control program must be co-ordinated and, in addition, must be fitted into the Russian, British and French programs designed to attain the same objective. That objective is real control over Germany's war-making potential, which, according to most competent observers, was much greater in 1944 than it had been in 1939.

WET STRENGTH PAPER is only one of thousands of items perfected for and supplied to the Armed Forces during the war and recently made available for civilian use. Designed primarily for map work, it was found suitable for charts, manuals and official papers subjected to rough treatment under adverse conditions. Maps printed on this paper can become rain, water or oil-soaked and still retain 40 to 60 per cent of their strength. Mud and grime can be washed off with soap and water or removed by dipping in gasoline. The paper can be written on or erased when wet and will retain to a large extent its resistance to folding, tearing, scratching and rubbing. The latest edition of HOH Lighthouse is printed on this paper and contains interesting descriptions of the plants of two of the paper companies that have been producing it.

RECONVERSION of the present great atomic bomb plants to peace-time purposes, including mobilization of the nation's scientists to apply atomic energy to industrial uses, is proposed in a bill introduced into the Congress by Representative Adolph J. Sabath of Illinois. The bill would authorize the President to spend as much as $2,000,000,000 for this conversion. No other country could build atomic bomb production plants similar to ours without our technical assistance, the Senate committee on atomic energy was told by Frank Creedon, resident manager for Stone & Webster Engineering Corp. during the construction of the Oak Ridge, Tenn., plants. Furthermore, he stated, it would take four years to build such a plant in this country in time of peace and seven or eight years elsewhere.

MAGNETIC PARTICLE TESTING can hardly be called a new method of inspection. The application of the method, however, has increased by leaps and bounds in a relatively small number of years. In many industries where ferrous metals are vital, the method is utilized widely, both for locating incipient defects in parts in service and as an inspection tool for the acceptance of new material. By definition, the magnetic particle method of testing and inspection is a method for detecting defects on or near the surface in suitably magnetized materials which employs finely divided magnetic particles that tend to congregate in regions of magnetic non-uniformity associated with the defects. A symposium on magnetic particle testing was held at the Philadelphia District Meeting of the American Society for Testing Materials, January 22, 1945. This is reported in detail with tentative standards now proposed by the society in a recent publication entitled, "Symposium on Magnetic Particle Testing."

DIESEL ENGINES no longer can be regarded as accommodating and tolerant consumers of petroleum fuels which cannot be used for other purposes, F. G. Shoemaker and H. M. Gadebusch, of Detroit Diesel Engine Div., told the 1946 annual SAE meeting. Development of high-speed Diesel engines for automotive installations has changed this situation, they said. The Diesel consequently is becoming more selective in its diet and is creating a demand for fuels having specific properties essential to efficient and prolonged operation. In fact, they added, experiments indicate that the type of service in which it operates now is the real criterion of the Diesel's fuel requirements. Power developed by the Diesel was said to appear to be directly proportional to the heating value of the fuel injected. Harry F. Bryan, of International Harvester Co., said that demands for smoother, cleaner operation of Diesels tend to require standardization of the ignition quality of Diesel fuels and to put a premium on combustion control.

DURING THE WAR, motor engineers were asked to build special direct current armatures to operate continuously at 600 F, in a vacuum of a few microns pressure. The armatures must give off no gases, must turn at 1200 rpm without vibration and without balance weights. They are wound with glass and silicone-insulated wire, placed in an oven at about 500 F to burn out organic materials and drive out volatiles, then subjected for hours to a filling of sodium silicate and mica dust under alternate vacuum and pressure.

HOW THE AEROTEC TUBE can be used to remove impurities and moisture from compressed air lines is told in Thermix Topix, Vol. 4, No. 1. Data are also given on other applications of the tube, as in railroad car air conditioning, dust classification and collection.

OPINION was expressed by Frank C. Mock, of Bendix Products Div., Bendix Aviation Corp., before the 1946 annual SAE meeting, that jet engine design should start with the combustion chamber in order to avoid troubles already being experienced in the form of hard starting, excessive temperatures, blow-out, and die-out. "Most of us," he said, "having had casual experience with combustion all our lives, all the way from bonfires to blowtorches, consider ourselves experts, and we tend to think this jet burner art is easy. This subject has not received sufficient attention thus far. Our engines are not aircraft engines, and our jet aircraft are not military service aircraft, unless combustion is positive and dependable under operating conditions. Therefore, the combustion chamber should be one of the first elements to be experimentally proven before a given engine arrangement is adopted."

PREFORMING steel tank sides to special hydrodynamic curves makes them very much stronger, one firm discovered in its own tank uses and tests. Properly-curved sides need no reinforcement to resist tremendous liquid pressures, simplifying and lightening the tank, thus saving much weight and first cost.

REPRODUCTIONS of early wood-cuts showing machine shops, engines, water wheels and other equipment of the 1870's, 80's and 90's are a feature of the attractive book just published by Woodward Governor Co. to commemorate its 75th year of operation. The book highlights the company's history, reviews its methods and illustrates its products and its men with many interesting photographs.

SKINNER gasoline engine built largely of aluminum and die casting (distinctly favorable with the present surplus of aluminum) has large power output—1.75-2 hp per pound is claimed. This is produced in part by 3-to-1 compression and high rotating speed made possible by ultra-light parts. Of the opposed or pancake type, it was designed for ready conversion from a 28-hp, 2-cylinder to multiples for larger powers. It fits automobile and airplane uses, auxiliaries, and the like.

A HEAT-ABSORBING color-transmitting glass may find furnace and power plant use. Developed to improve projection of color pictures and absorb much of the unendurable heat on motion picture and television actors and operators, the new glass absorbs 90 per cent of objectionable heat. It is used also as a heat screen for spotlights and floodlights and to protect films and slides against damage or burning.

A NEW OIL-SPRAY for furnaces uses a roller dipping into an oil tank, taking up a thin film which is thrown off in a finely-divided condition by a bristled brush rotating against it. The spray is mixed with air and then burned in the usual way. By varying the speed of the pick-up roller, the amount of oil can be controlled very closely.

SIMPLE new two-piece spherical bearing, usable whenever rigidity is at a premium or alignment too costly or impossible, developed for war work and now available commercially in any quantity, any shaft size, is the Halfco. This is made with a one-piece bronze outer race into which a hard chromium-plated steel ball, with center hole drilled through it, is pressure-inserted.

A NEW OIL CLEANING machine also dehydrates, de-gasifies and stabilizes used oil through atomizing in a vacuum, raising its dielectric value. Placed in the power plant's transformer and circuit breaker oil system, it maintains the oil at correct insulating values. It may also be used for other processes requiring oil cleaning.

NEW CEMENT for flooring drives away insects, kills bacteria, prevents formation of mold, dissipates static electricity. And a transparent finish for floors is unaffected by extreme acidity or alkalinity. Dried films of this material have been immersed in dilute sulphuric, carbolic, sodium hydroxide solutions with no damage to finish or gloss. Maybe this would solve the vinegar-on-the-floor problem (P. E. & E., January, 1946, page 93).

CODE OF MINIMUM REQUIREMENTS for Instruction of Welding Operators, Part A, Arc Welding of Steel 3/16 to 3/4 in. Thick has just been issued in the form of an 84 page booklet by the American Welding Society, 33 West 39th Street, New York, price 50 cents.

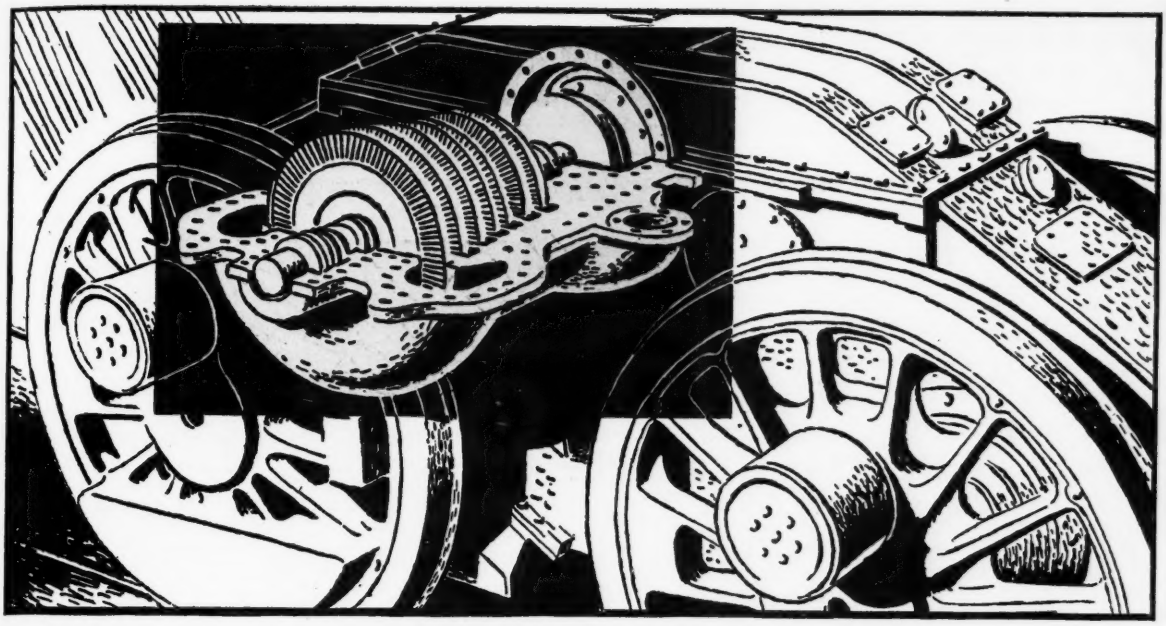
THE FONBERG, "simplest engine in the world" is a semi-jet motor of unusual design, consists of a nozzle in a tube mounted on a supporting structure that has a free-moving arm to permit the engine to rotate about a shaft. Space between nozzle and outer wall allows air to flow through the small holes of the nozzle during combustion, the combustion gas jet providing the propulsive force.

ISOMODE, a new vibration isolator for machine and other suspensions, consists of two metal flanges with a shouldered, molded-rubber core between. This permits separate motions in all directions. It is simple, efficient, permits high deflections.

WHERE TO USE the Bucket Trap, a good discussion showing where to install it and where not to install it is given in the October, 1945, issue of Weather Magic.

WHAT PROMISES to be an efficient, cheap, new heat insulator is being used under the steel roofs of new automobiles: steel shavings bound together with animal glue. It insulates against noise also.

A NEW LOCKNUT has a lower portion connected to the nut proper by a very thin wall. In setting up tight this is broken loose, its threads compressed, its cone gripping the mating threads of the bolt positively.



New Steam Turbine Locomotive

MAKING RAILROAD HISTORY

...with the aid of a SHELL LUBRICANT

TODAY a huge, new kind of locomotive is speeding over the countryside. This locomotive has no cylinders, pistons or driving rods. Its 6900 shaft horsepower comes from a steam turbine no larger than a refrigerator.

More than 1000 chromium steel blades are mounted on the rotor shaft inside the turbine housing. Steam, shot into the turbine through dozens of nozzles, strikes the first row of blades at 2000 mph, forcing the shaft to revolve. When the locomotive is traveling 100 mph the tips of the largest blades will be traveling nearly 700 mph.

Turbines such as these are subjected to terrific heat, and require a lubricating oil that can do three jobs: 1. Act as a coolant. 2. Lubricate thoroughly. 3. Protect against rust. It also must resist oxidation and sludging which might clog strainers and feed lines, slowing up the oil flow to the bearings. The reduction gearing, 97% efficient and involving high gear tooth pressures, would also be affected.

In Shell Turbo Oil the engineers found the lubricant that can do the job so essential in such high-speed, high-temperature operation. Shell Turbo Oil provides adequate anti-rust protection, and possesses high stability toward oxidation.

* * *

For more facts on Shell Turbo Oil get in touch with Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York; or 100 Bush Street, San Francisco 6, California.

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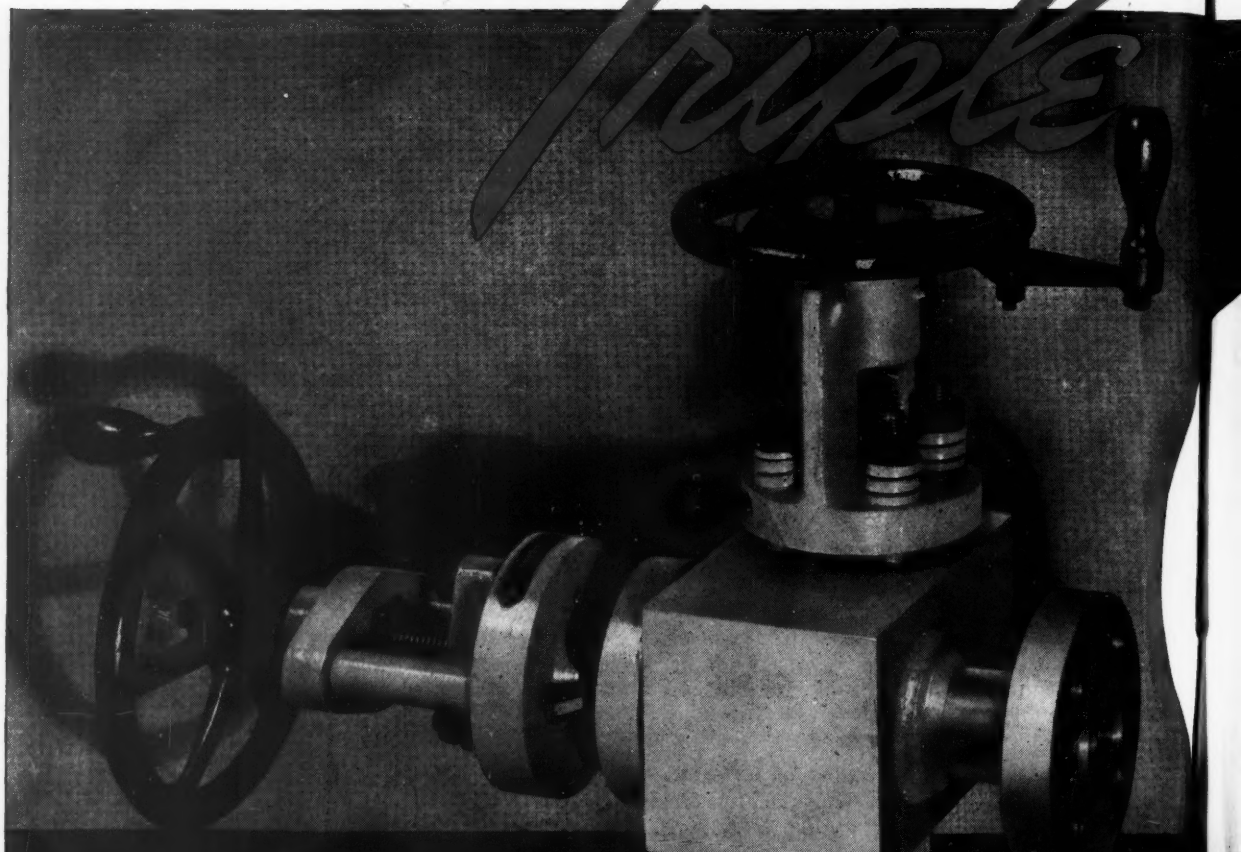
Triple



YARWAY UNIT TANDEM BLOW-OFF VALVES, built for pressures up to 2500 psi. Combining a Hard-Seat and a Seatless Valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing or for draining and sealing—in a compact, rugged unit.

Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special alloys and unique construction features to reduce normal wear in this type of valve. Ask for Catalog B-432.

YARWAY STEAM PLANT EQUIPMENT

NEED THIS...

Protection

Modern Steam Generating Units represent big investments. They are worthy of the best auxiliary equipment available.

Power engineers have found it sound judgment to insist on Yarway Tandem Blow-Off Valves, Yarway Water Columns and Gages, and Yarway Remote Liquid Level Indicators . . . have learned through experience that these are the best protection for their major investment.

Sound design and careful attention to every mechanical and metallurgical detail are the reasons for Yarway performance and leadership. Nearly 40 years' experience with power plant problems—and constant research and development to keep abreast of Industry's requirements—justifies the slogan "Yarway-Equipped—A Mark of Good Engineering."

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114 Mermaid Avenue, Philadelphia 18, Pa.

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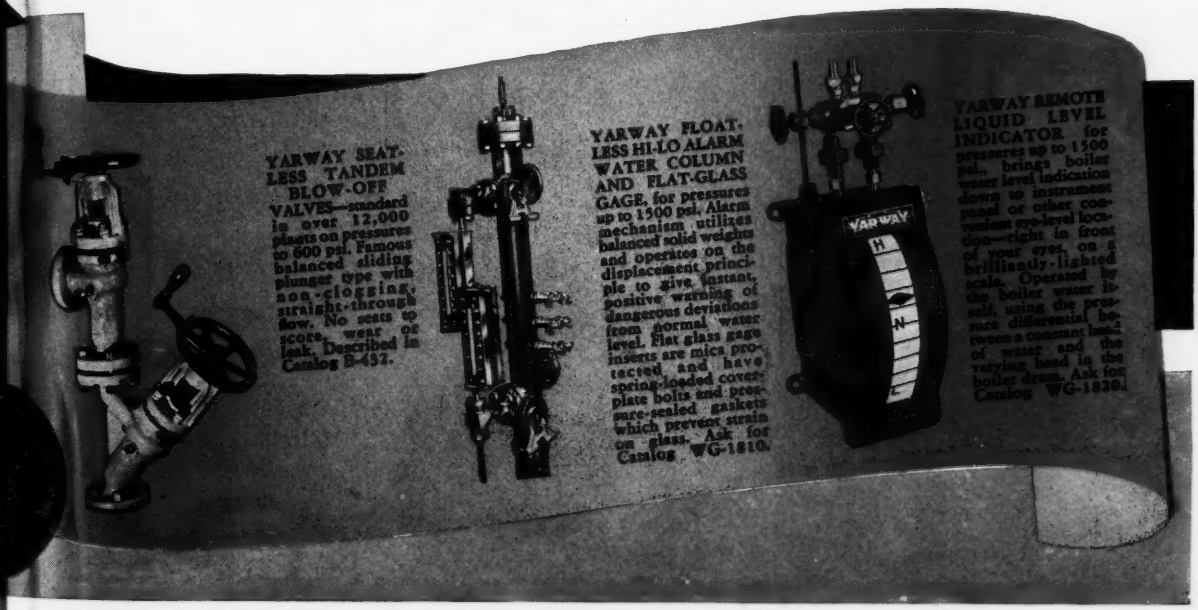
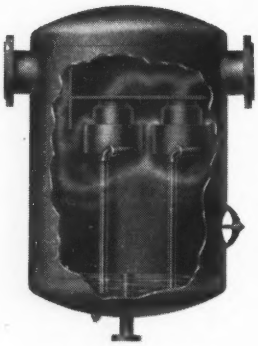
Blow-Off Valves, Water Columns and Gages, Liquid Level Indicators, Expansion Joints, Impulse Steam Traps, Strainers, Spray Nozzles.

Ask about the new Yarway 30-minute color and sound motion picture, available for group showings.


YARWAY SEATLESS TANDEM BLOW-OFF VALVES—standard is over 12,000 pieces on pressures to 600 psi. Famous balanced sliding plunger type with non-clogging, straight-through flow. No seats to score, wear or leak. Described in Catalog B-452.
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN AND FLAT-GLASS GAGE, for pressures up to 1500 psi. Alarm mechanism utilizes balanced solid weights and operates on the displacement principle to give instant, positive warning of dangerous deviations from normal water level. Flat glass gage inserts are mica protected and have spring-loaded cover-plate bolts and pressure-sealed gaskets which prevent strain on glass. Ask for Catalog WG-1810.
YARWAY
H
N
L
YARWAY REMOTE LIQUID LEVEL INDICATOR for pressures up to 1500 psi., brings boiler water level indication down to instrument panel or other convenient eye-level location—right in front of your eyes, on a brilliantly-lighted scale. Operated by the boiler water itself, using the pressure differential between a constant head of water and the varying head in the boiler drum. Ask for Catalog WG-1820.



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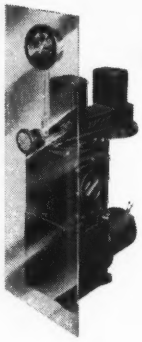
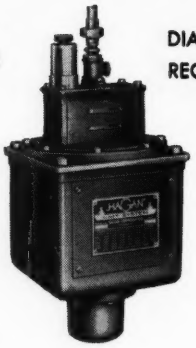
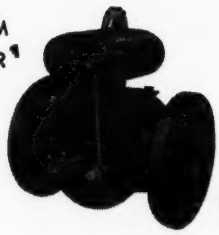


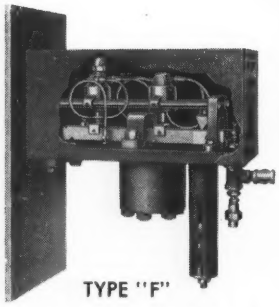
TYPE 2 SO REGULATOR



DIAPHRAGM REGULATOR



V PORT BUTTERFLY VALVE



TYPE "F" MASTER SENDER

If you need equipment for any of these applications

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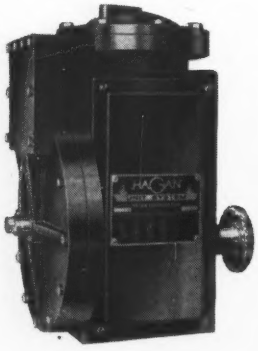
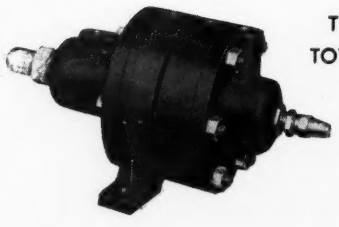
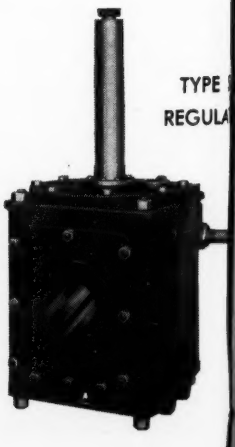


RECEIVING REGULATOR



TYPE F TOTALIZER



TYPE REGULA

Combustion rate of boilers

Constant or graduated draft

Constant or graduated pressure (F.D.)

Feeder or stoker speeds

Flow of liquids

Control of multiple fuel firing

Fan speed control

Pump speed control

Hydraulic coupling control from speed or delivery of driven unit

Constant differential pressure (liquids or gases)

Constant differential draft (liquids or gases)

Graduated differentials (automatically or manually—liquids or gases)

Control of steam pressure

Control of pump discharge pressure

Control of pump discharge flow

Steam flow control

Steam pressure reduction

Steam temperature control (superheat)

Removal of oil and solids from exhaust steam

Removal of oil and moisture from compressed air

Steam desuperheating control

Separately fired superheaters

Flow of gases

Ratio control of gas flows

Ratio control of fuel and air (boilers)

Remote manual or automatic control

Flash tanks for recovery of steam from continuous blowdown systems

Program control for firing cycle

Oil burner control

Oil burner fuel-air ratio control

By-pass damper control for air preheater protection

Feed water heater pressure control

Feed water heater temperature control

Liquid level control

Control of multi-speed motor drives

Safety protection for gas or pulverized coal firing

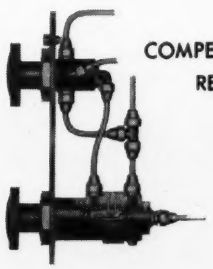
Steam jet refrigeration control

Removal of excess moisture and solids from saturated steam

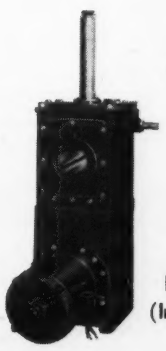
Force measurement and control

Measurement and control of Thrust and Torque

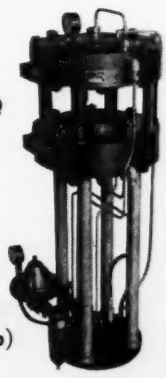
HAGAN
HALL
BUROMIN
CALGON



COMPENSATING RELAY



HAGAN THRUSTORQ



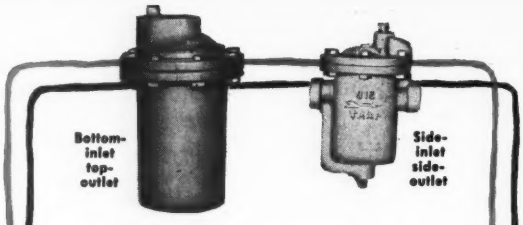
TYPE SO REGULATOR (Integral Pump)

HOW TO TRAP

PIPE COIL RADIATION

...for lower fuel consumption

One of a series of advertisements, each discussing trapping practice on a different class of equipment.



Pipe Coil Trapping Tips*

- Select traps of sufficient capacity to handle the warming up load.
- Select traps with adequate automatic air removal capacity.
- Where extremely fast heating is desired, use traps with automatic air bypass.
- Be sure pressure on supply side of trap is higher than in return line.

*Complete data, diagrams, tables, capacities, selection factors in 36-page CATALOG H, available on request.

No. 213 Trap Drains Lines in 30 Seconds!

The correct selection and installation of steam traps for draining pipe coils pays big dividends in fuel savings, faster heating and higher temperatures. At the Plylock Corporation, Portland, Oregon, Armstrong traps were installed on a Coe lumber drier after tests showed no steam loss and drainage of condensate in 30 seconds after lines were shut off eleven minutes to allow condensate to accumulate. Other reports from Armstrong users include: 190% return on trap investment; saving of 211 tons of coal per season; saving of carload of coal per trap; $1,067 coal saving.

Many engineers may question how a few steam traps can effect such fuel savings. The explanation is not difficult:

1. Armstrong traps don't leak steam.
2. Armstrong traps automatically discharge air that would otherwise reduce heat transfer efficiency.
3. Armstrong learned the hard way from practical experience on thousands of installations what sizes and types of traps to use and where and how to install them—you can profit from this. For the name of the nearest Armstrong distributor, address: ARMSTRONG MACHINE WORKS, 810 Maple Street, Three Rivers, Mich.

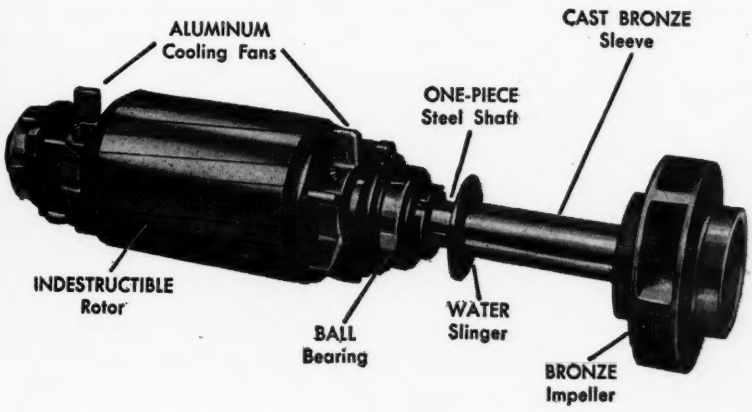
ARMSTRONG *Inverted Bucket* STEAM TRAPS

Over a Million in Use...For Power...Process...Heating

Here's Key

to Why A-C's Smooth-Running Electrifugal Pump is the Finest of its Kind!

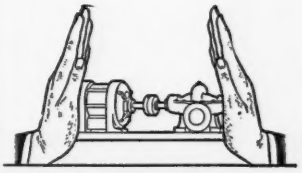
SQUEEZE PLAY CUTS SPACE 33%!



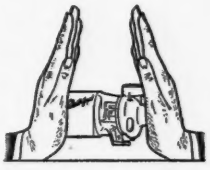
NEW KIND of pumping power now gives you new standards of performance and economy! Allis-Chalmers engineering has combined pump and motor into a single, compact unit—the "Electrifugal" Pump—which takes less space, gives you smooth operation with maximum protection against dangers of abnormal wear, leakage, corrosion, vibration! One-piece iron casting forms motor yoke, bearing housing, pump bracket and feet. One shaft running on 2 ball bearings carries the motor-rotor and pump impeller (see above). Result: true alignment, smooth operation—less maintenance! For you that means extra strength, extra value in terms of operating economy and long life. For complete information about this great pump, call our nearest office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

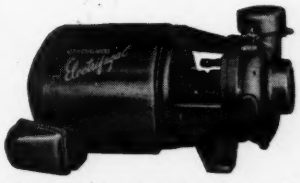
A 1933



PROBLEM: Here is conventional pump and motor. How can we couple them together *better*—to save space, increase stability, and provide rigid alignment.



SOLUTION: We design a new kind of pumping unit—the one and only "Electrifugal" Pump! Motor and pump are now on one shaft—which cuts space 33%, assures alignment and smooth operation. No wonder "Electrifugals" give you more pumping power for your money!



SEA-BLUE BEAUTY: Modern design of Electrifugal Pump looks well on jobs anywhere! Capacities from 15 to 1600 gpm—heads up to 500 feet.

ALLIS-CHALMERS *Electrifugal* PUMPS

IT IS TRUE that the Perfect Spread Stoker has a 17-year record of *proved* performance and economy in 15 types of industries. It is also true that recent redesigning has greatly improved and simplified its operation. Here, now, is a vigorous employee that will work 'round-the-clock for you—producing more steam *automatically* at lower cost than you believed possible.

Feed this stoker the lowest available grades of coal and other solid fuels—wet, dry or partially frozen. Defy it to clog or fail or to let you down when steam is needed most. Then watch it continue spreading a "perfect" fuel bed at infinitely variable rates of speed by the dependable *overthrow* method. Hear how quiet it is, see how easy to operate, and how accessible are all parts—because they're protected by functional streamlining. Most important, watch this new addition to your boiler room staff quickly pay for itself out of fuel and maintenance savings. Please write and ask for the Æ Perfect Spread Stoker booklet.

Æ PERFECT SPREAD STOKER
With stationary grates, dumping grates or continuous ash discharge—up to 400,000 lbs. of steam per hr.
WON'T CLOG ON Wet COAL!
Forget your wet coal problems! Get steady, reliable fuel firing with the stoker that thrives on wet or partially frozen coal—that has the exclusive Æ non-clog feature!
OTHER Æ PRODUCTS: Æ-TAYLOR STOKERS, LO-HED HOISTS, MARINE DECK AUXILIARIES, HELE-SHAW BLIND POWER

AMERICAN ENGINEERING COMPANY

2408 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA

Highballing Power ...and *Profits!*

This cutaway drawing was prepared with the cooperation of the American Locomotive Company.

Get this Complete Lubrication Program for all your machines

- **Lubrication Study of Your Entire Plant**
- **Recommendations to Improve Lubrication**
- **Lubrication Schedules and Controls**
- **Skilled Engineering Counsel**
- **Progress Reports of Benefits Obtained**

GARGOYLE Lubricants

POURING on the power—at high speeds—this big Diesel electric locomotive combines many lubrication problems similar to those in your plant.

Here, inside this power-plant-on-wheels, as in a stationary power plant, Socony-Vacuum's correct lubricants for every machine give more continuous operation at lower costs.

In this Diesel, for instance, gas temperatures soar to above 3000° F., pressures to above 600 lb. per sq. in. Gargoyle D.T.E. Oils stand up under this heat and pressure, reduce wear and blow-by to a minimum. The same stable lubricants protect vital parts of the generator and turbo-supercharger.

Those driving motor pinions and gears operate under temperature variations of from minus 50° F., to 140° F., with dust and water often present. Gargoyle Compounds stick on the job, and protect against wear. On the many grease-lubricated parts Gargoyle greases stand up for long periods of time and provide Correct Lubrication.

Why not get all these benefits now ... for your plant?

Socony-Vacuum Oil Co., Inc.

and Affiliates: Magnolia Petroleum Co. · General Petroleum Corp. of Calif.

TUNE IN "INFORMATION PLEASE"—MONDAY EVENINGS, 9:30 E.S.T.—NBC

Illustration shows GARLOCK 234 Braided Asbestos Packing in Coil form. GARLOCK 244—Coil with wire. GARLOCK 239—Rings. GARLOCK 249—Rings with wire.

QUALITY *Controlled* from Start to Finish

Garlock 234 Packing is manufactured from raw material to finished product in the Garlock factory. *Quality is controlled* from start to finish. Like other Garlock products, 234 is uniform and can be depended on—for long, economical service. Use GARLOCK 234 on rotary or centrifugal pumps handling hot water, cold water, caustic solutions or weak acids.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

This New Data Book No. 1000

Contains Complete Information On

Republic Pneumatic Transmitters

OPERATING ON THE FORCE-BALANCE PRINCIPLE

for the measurement
and control of
FLOW
PRESSURE
LIQUID LEVEL
LIQUID DENSITY
DIFFERENTIAL VAPOR PRESSURE

A Copy of This 28 Page Data Book Will Be Mailed On Request

REPUBLIC FLOW METERS CORPORATION
2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

The verdict of the Insurance

This incident occurred in a municipal electric plant in an Ohio community. It isn't a large plant—two 312 horsepower boilers, operating at 200 psi. It is one of those plants that seldom appear in the engineering publications but which collectively account for well over half the stationary steam power generated in this country.

There never had been enough trouble with these boilers to make this plant newsworthy. Tubes had to be turbined rather frequently, but it was possible to keep them clean enough to avoid any prolonged interruption of service.

Nevertheless, the engineer in charge felt that boiler water conditioning could be improved, and early in 1945 he started to use the Hall System. Hall engineers made their usual study of water supply and operating conditions, set up the proper procedure, and taught the plant operating personnel how to make the necessary tests.

Periodic check-ups showed that the plant was evidently following the procedure carefully. No troubles developed—and that is, after all, the main objective of boiler water conditioning.

About seven months after the Hall System was started, the inspector for the boiler insurance company paid his regular visit—and his report summed up the results of those seven months.

"I don't know what you've been doing to these boilers," he said, "but whatever it is, keep it up. *These tubes are 100 per cent cleaner!*"

There is nothing spectacular about the story. It is not a startling achievement—just a routine example of our regular job, effectively done. But it is, we believe, just the kind of case history you would like to have for your own plant.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

(a subsidiary of Hagan Corporation)

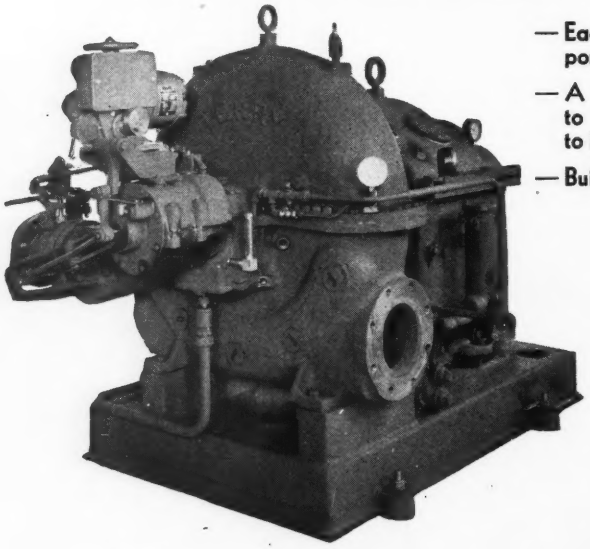
HAGAN
HALL
BUROMIN
CALGON

...Inspector...

HALL SYSTEM *of Boiler Water Conditioning*

The TERRY

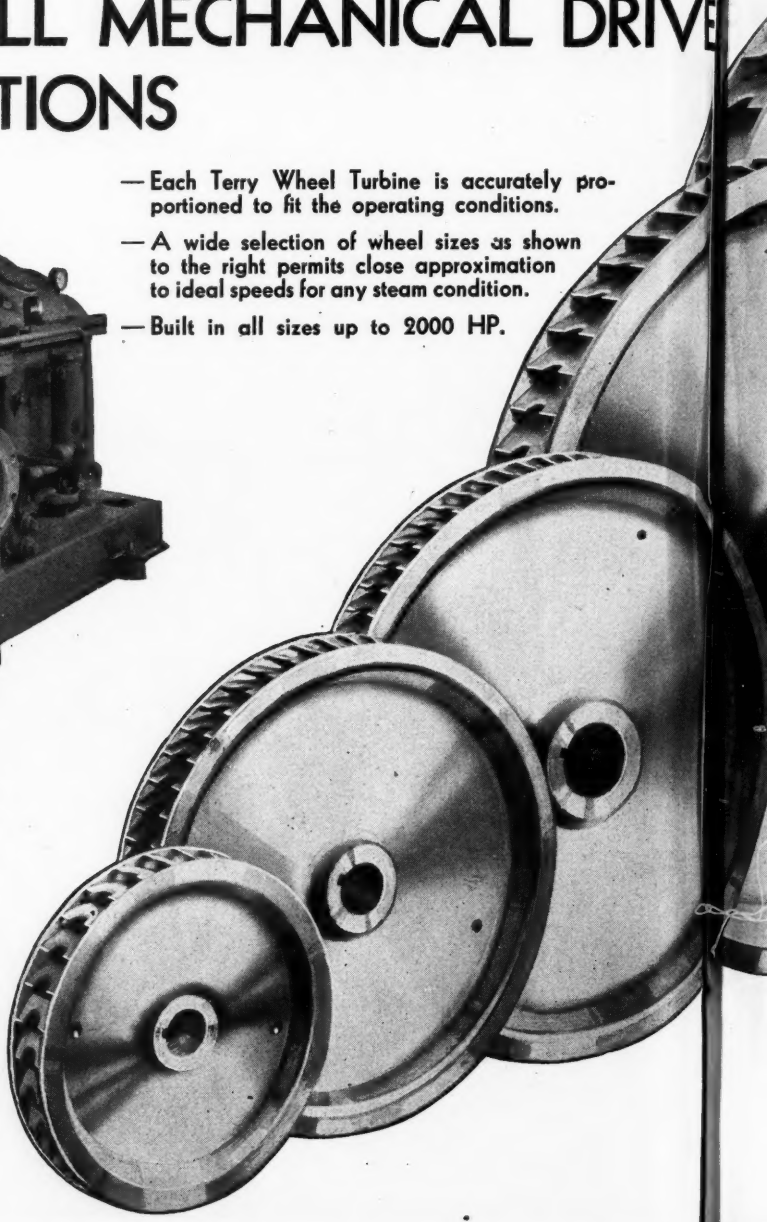
—IS BUILT IN A WIDE RANGE O SIZES FOR ALL MECHANICAL DRIVE APPLICATIONS



— Each Terry Wheel Turbine is accurately proportioned to fit the operating conditions.

— A wide selection of wheel sizes as shown to the right permits close approximation to ideal speeds for any steam condition.

— Built in all sizes up to 2000 HP.



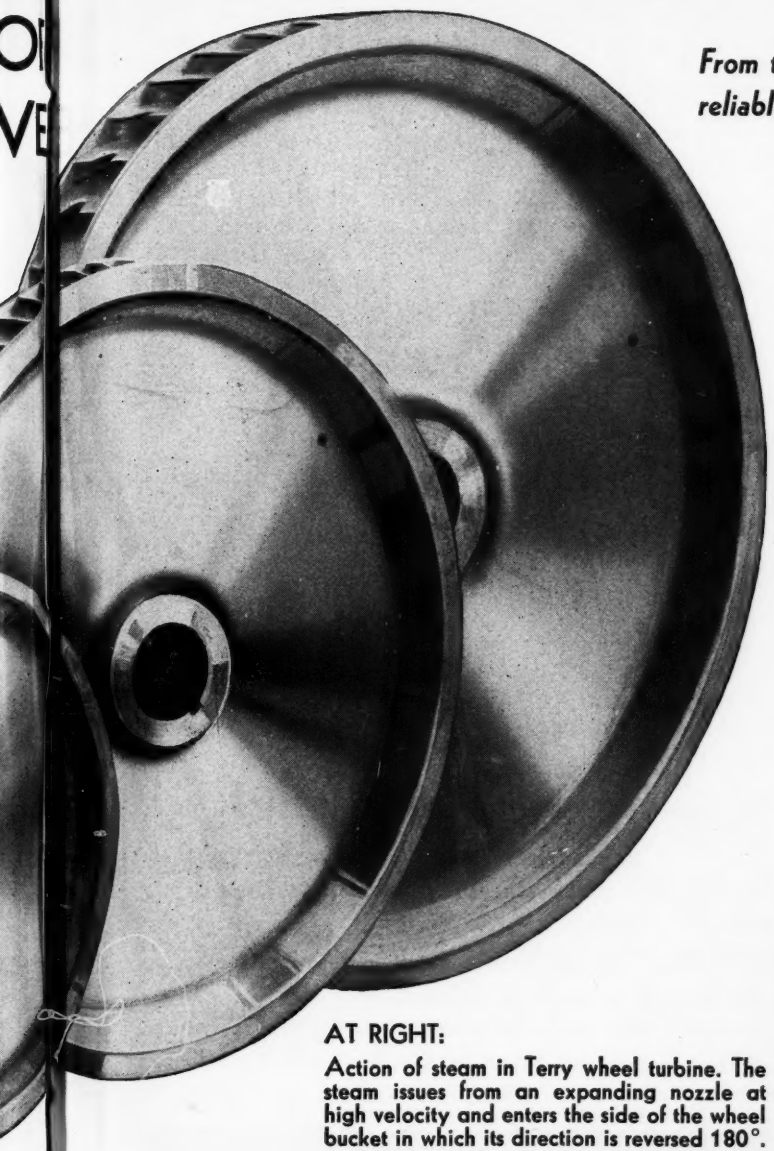
ABOVE:

Typical Terry Solid Wheel Turbo-Gear Unit. Rated 160 HP at 4000 to 1720 RPM with steam conditions of 400 lbs., 750°F.TT, 30 lbs. Used for Blower Drive.

FOR FULL DETAILS ASK FOR BULLETIN S-116

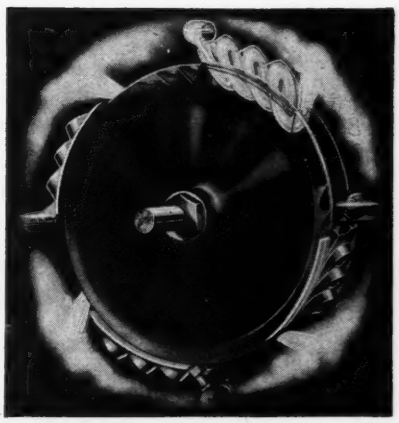
THE TERRY STEAM TURBINE CO.

Wheel Turbine



From the smallest to the largest these reliable turbines have—

- ★ Indestructible one piece wheel.
- ★ Large radial and axial clearances.
- ★ Double rim protected blading.
- ★ Individual nozzle control.
- ★ Dependable and durable governor.
- ★ Heavy dust-proof bearing and governor housing.
- ★ Independent overspeed trip with separate valve.
- ★ Sturdy casing design.
- ★ Strong and easily inspected steam strainer.
- ★ Truly accessible construction, which makes inspection of the interior parts a simple matter.



AT RIGHT:

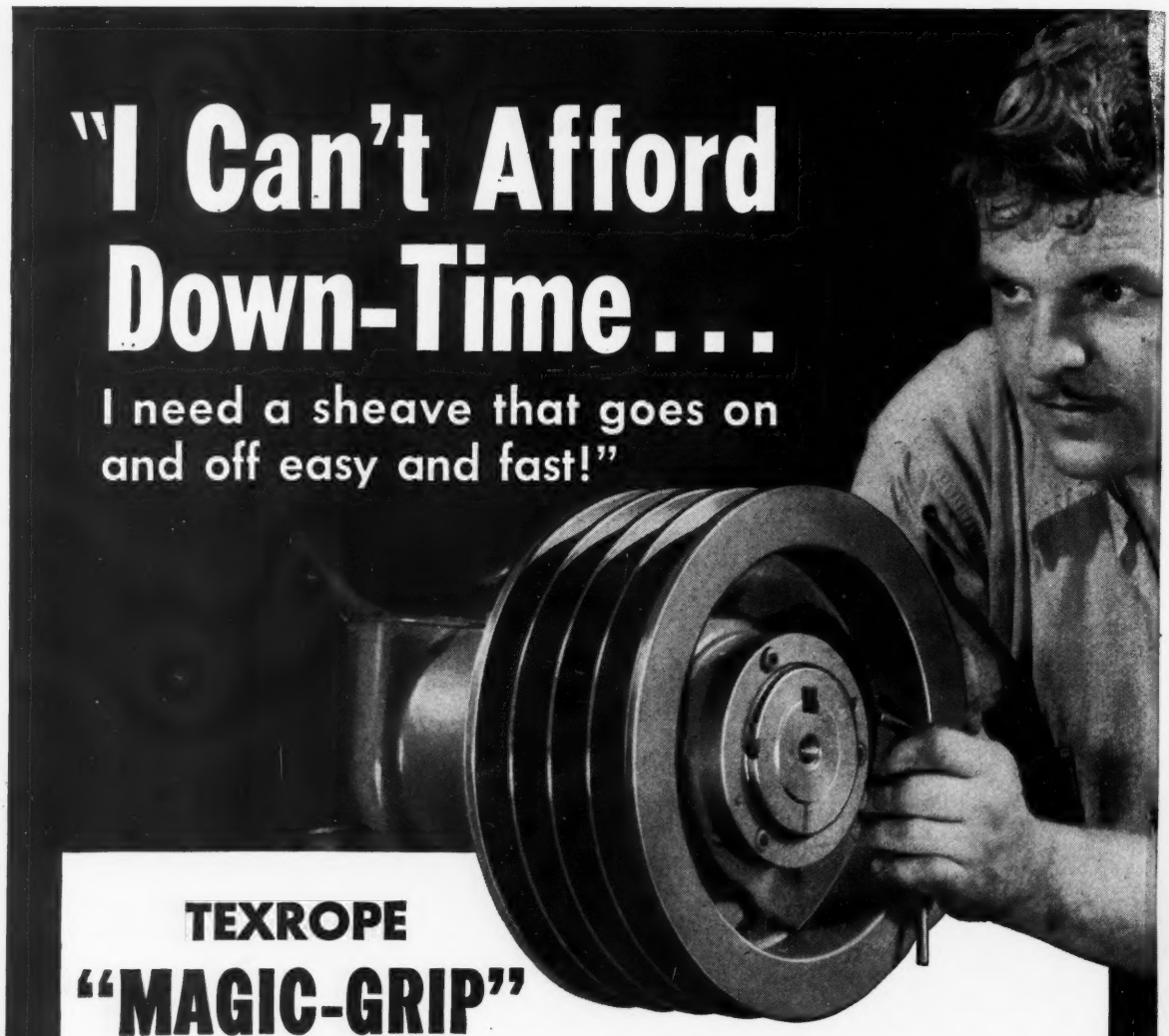
Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

T-1159

TERRY SQUARE - HARTFORD, CONN.

"I Can't Afford Down-Time . . .

I need a sheave that goes on and off easy and fast!"



TEXROPE "MAGIC-GRIP"

. . . Fastest Mounting Sheave Ever Made!

Saves manhours . . . this improved sheave with "Magic-Grip" bushing comes completely assembled. You slide it on the shaft to exact position, tighten three cap screws — and it grips like magic. No filing or scraping, no hammering. And it comes off just as easily!

More advantages: "Magic-Grip" sheave *mounts close to the motor.* Less overhang, less vibration, less strain on bearings. *Clamp fit can't damage shaft.* No wobble, shear or backlash.

You get these advantages without increase in prices! See "Magic-Grip" sheaves — at your nearest A-C district office or dealer. For literature, write to ALLIS-CHALMERS, Milwaukee 1, Wisconsin.

A 2004

V-BELTS

TEXROPE complete line — Sizes, types for every power transmission problem and condition.

ALLIS CHALMERS

TEXROPE V-BELT DRIVES

ORIGINATORS OF THE MULTIPLE V-BELT DRIVE

SHEAVES

"MAGIC-GRIP" . . . TEXSTEEL . . . TEXDRIVE . . . Speed changers and VARI-PITCH sheaves.

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

SIMPLEX VENTURI TUBES

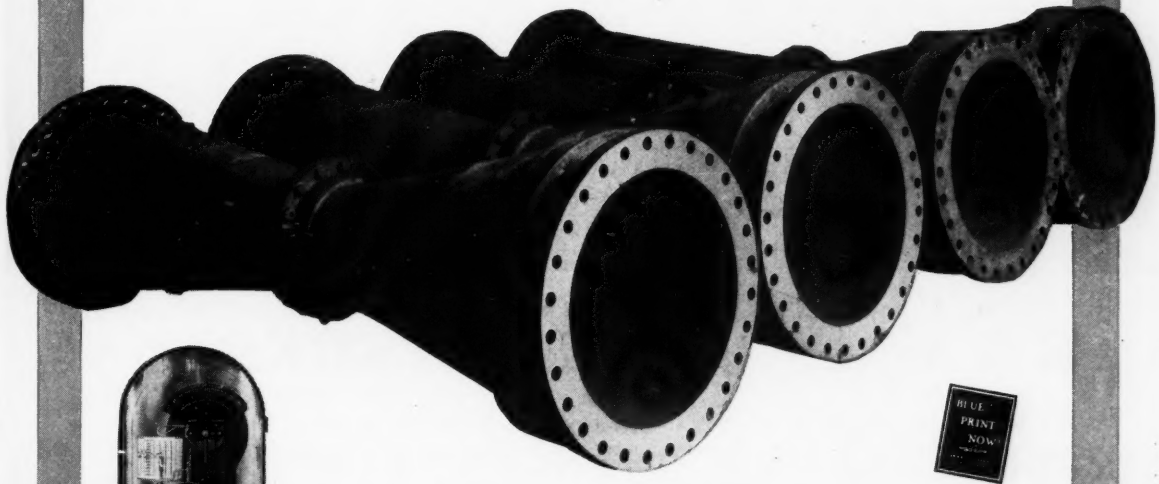
the ULTIMATE IN *Venturi Efficiency*

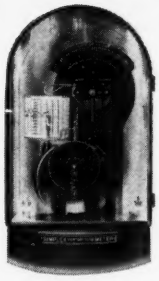
For a given flow of water, the Simplex Venturi and its Simplex Meter will measure with the least loss of energy, and the greatest accuracy over the widest range of flow!

The high constant efficiency with which the Simplex Venturi utilizes the differential head which it creates, has been proved by over 40 years of research and manufacture.

This highly-engineered primary device assures minimum head loss and normal, dependable coefficients. The unit is homologous in type and form; the tube throat is bronze-lined with extremely accurate piezometer taps; the pressure belt type design is essential to high and unvarying accuracy.

The venturi tube is accepted as being the most efficient of primary devices. . . . Installations as part of pipes and conduits of cast material and of fabricated structure, have proved the Simplex Venturi to be unsurpassed in installed operating efficiency!

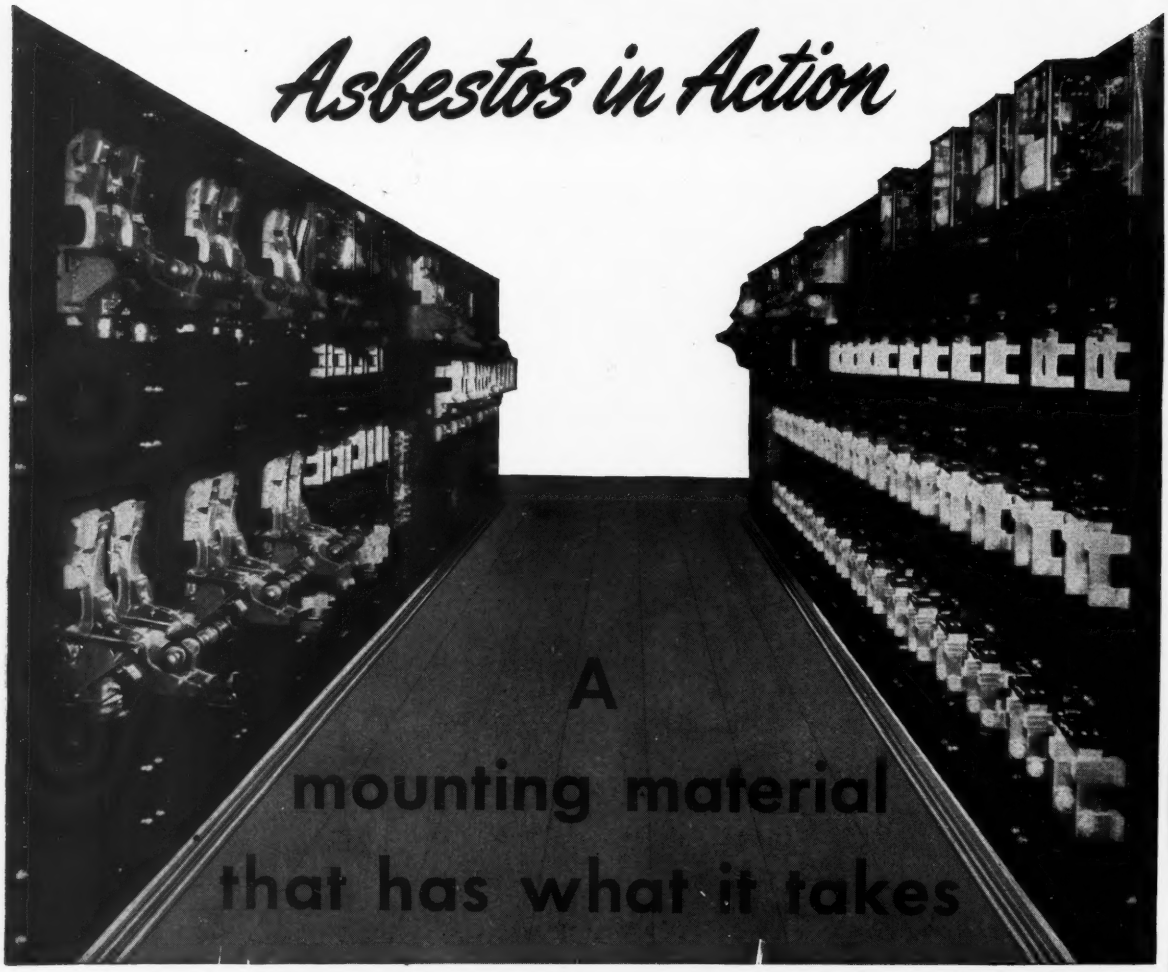




THE MO METER COMPLETES THE PICTURE

The "MO" is the "Master" Meter that converts the differential head created by the Simplex Venturi into rates of flow and indicates, records, and totalizes that flow with the maximum overall accuracy. This combination of Simplex primary device and MO Meter provides a standard of operating efficiency for the flow measurement of water, sewage and process liquids ni many municipal and industrial plants. The MO Meter is of such high accuracy that it may be utilized for testing the accuracy of other metering equipment. Write for Bulletin 300 — "The Simplex MO Meter."

SIMPLEX VALVE & METER CO.
6783 UPLAND STREET, PHILADELPHIA 42, PENNA.



K&M EBONIZED ASBESTOS

This modern electrical insulating material—developed specifically for switchboards, bus bar runs, testing tables, panel boards and similar uses—measures up fully to the most rigid requirements encountered in such service.

The dielectric strength of a ¼" sheet of K&M Ebonized Asbestos will withstand 19,000 volts without puncture . . . a 1" sheet, more than 53,000 volts.

It has the structural strength needed to hold heavy switches and instruments firmly and securely. It will withstand severe shock, vibration, sudden temperature changes . . . is highly resistant to oil and water . . . and will not shrink, crack or bulge.

The ability of K&M Ebonized Asbestos to meet all service conditions is due to its rugged construction and special composition—a combination of asbestos fibre, binding cement and insulating compound, moulded under high pressure into monolithic sheets of uniform density throughout.

K&M Ebonized Asbestos is available for immediate delivery . . . in thicknesses of ¼" to 4", standard or special "panel" finish. It meets the technical requirements of the Underwriters Laboratories, Inc., when built into an assembled unit.

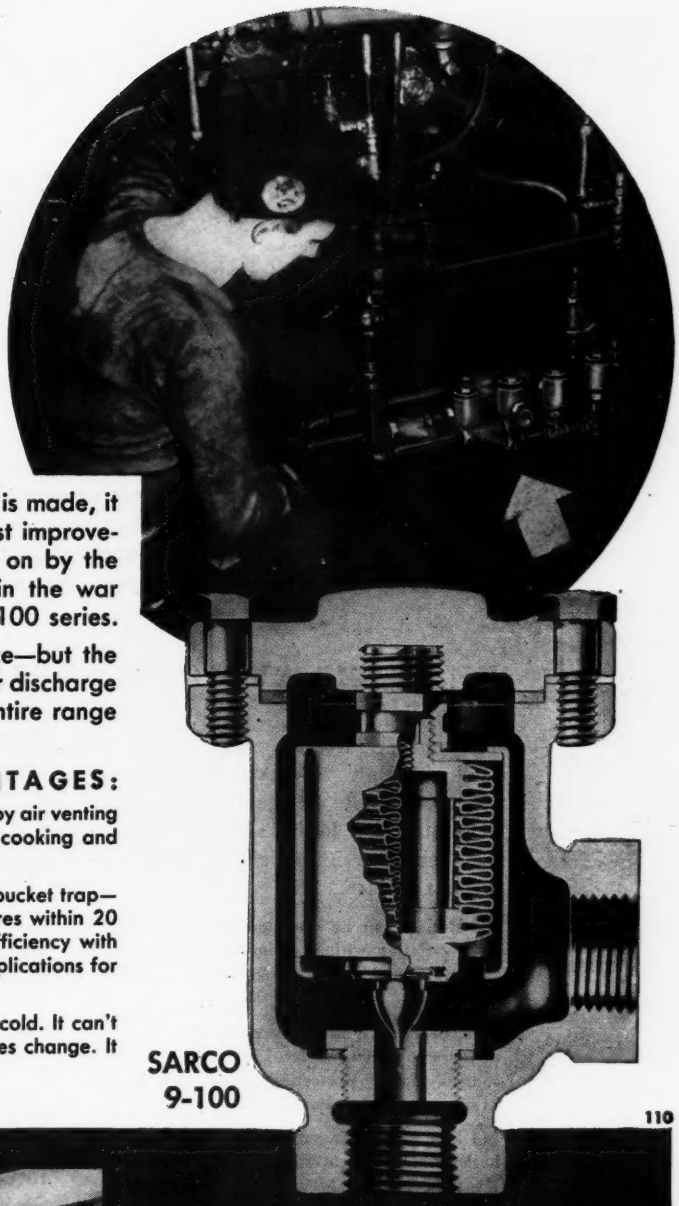
Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

NOW TWICE AS GOOD—

THE NEW SARCO THERMOSTATIC STEAM TRAP



Whenever a better thermostatic steam trap is made, it will still be called "Sarco No. 9." The latest improvement, after years of development spurred on by the tremendously expanded use of this trap in the war effort, is now ready for you in the new 9-100 series.

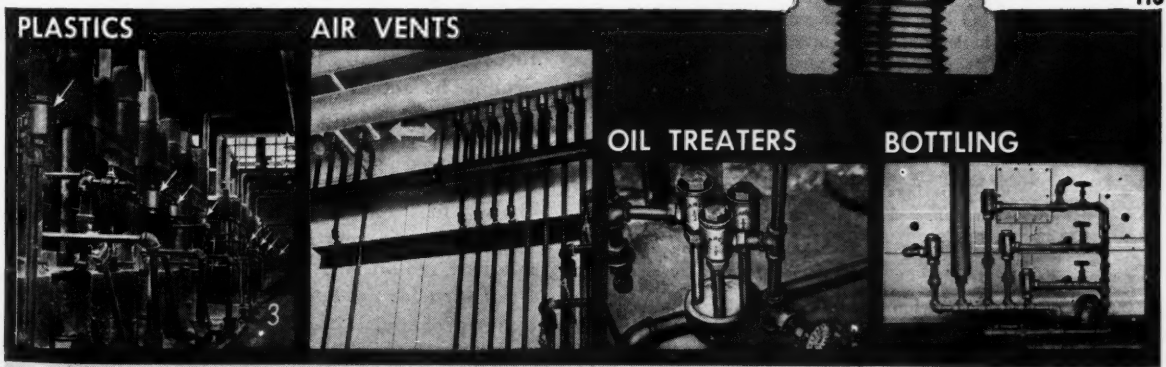
No larger—not much change in appearance—but the valve orifices are larger and the capacity for discharge of *condensate* or *air* is doubled over the entire range of sizes.

HERE ARE SOME OF THE ADVANTAGES:

1. In process work, cooking time is governed more by air venting than trap capacity or speed. Actual output of cooking and similar equipment will be greatly increased.
2. The new No. 9 will operate almost as fast as a bucket trap—but have full capacity at condensate temperatures within 20 degrees of the steam. It is thermostatic trap efficiency with bucket trap capacities—a whole new field of applications for the No. 9.
3. Like other No. 9's, this trap is wide open when cold. It can't freeze. It requires no seat change when pressures change. It is small, inexpensive and easy to install.
   Ask for Bulletin No. 250.

SARCO 9-100

110



FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

ARMY E NAVY

SARCO SAVES STEAM

Represented in Principal Cities

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y. • Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

cleaner,

drier steam from

Elimination of solids and moisture from steam leaving boiler drums, and an assurance of positive boiler water circulation, are accomplished with an unusual degree of effectiveness by the B&W Cyclone Steam Separator. Seven years of wide use in Babcock & Wilcox boilers have thoroughly proved the efficiency of the B&W Cyclone Steam Separator for the consistent and reliable production of clean, dry steam.

WHAT THE CYCLONE DOES:

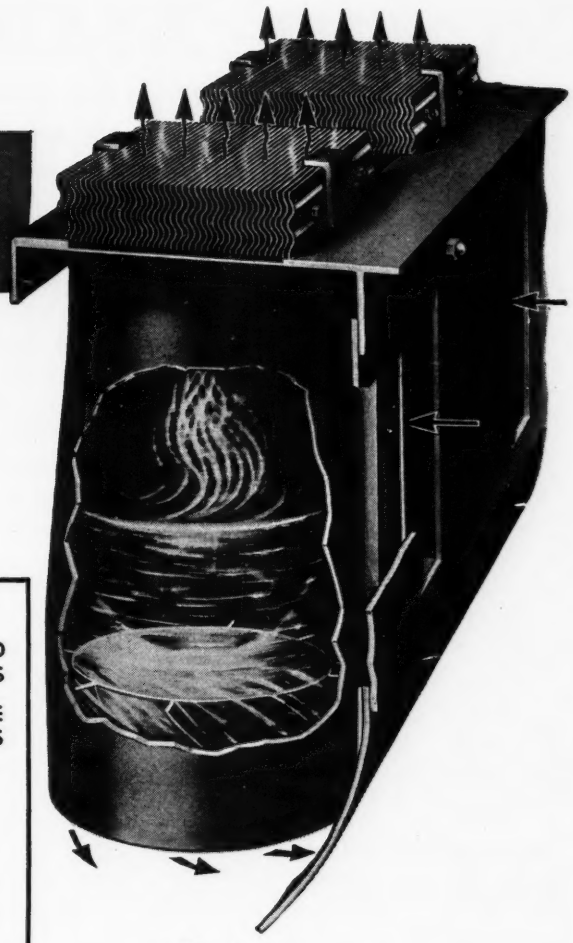
The separation of the water and its attendant solids from the steam is so nearly complete in the Cyclone Steam Separator that boiler and turbine performance are improved in many important ways:

1. Boilers can be operated at greater water-level variation without priming, making larger and more rapid load swings safely possible.
2. Complete separation of the steam from the water produces a maximum circulating head and delivers solid (steam free) water to the downcomers, thereby protecting boiler tubes against overheating and burnout.
3. Dry steam is assured over wider range in boiler water concentration.
4. Superheater tubes are protected from burnouts and failure due to scale deposits.
5. Longer periods of continuous boiler operation are secured.
6. Savings in maintenance time and expense are effected in boilers and turbines.
7. Safety is promoted by reducing variations between water levels in drum and gauge glass.
8. Turbine blades stay clean longer, permitting longer operating periods between cleanings.
9. Desired KW output can be maintained for longer periods.

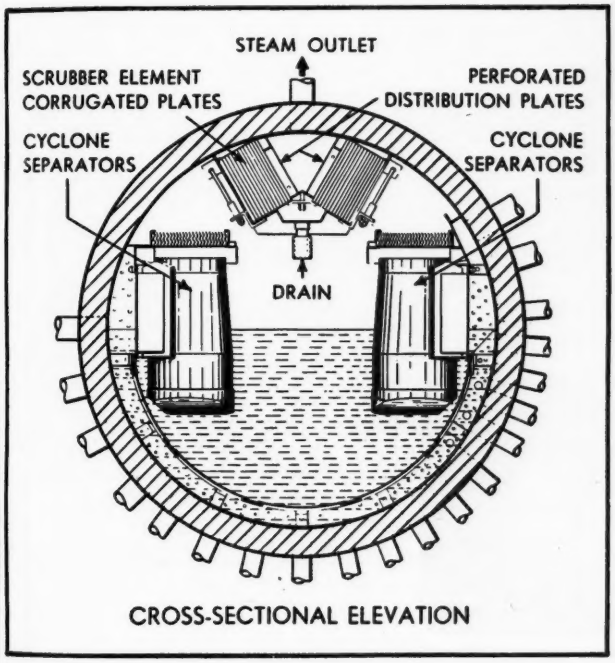
Separation of the water from the steam by the Cyclone Steam Separator is a continuous action. The kinetic energy of the steam and water mixture entering the Cyclone forces the water and any entrained impurities to the wall of the cylinder, while the nearly pure, dry steam passes out at the top between corrugated scrubber plates. The water swirls down the cylinder wall to the bottom, where kinetic energy is again utilized to force the water through directing vanes with sufficient velocity to overcome the head of water in the drum. The action within the separator prevents its flooding, and assures the delivery of clean, dry steam at all times.

The Cyclone Steam Separator is another B&W "first" in the development of better steam-generating equipment — another reason why it pays to *see B&W first* for the latest solution to any steam problem.

a cyclone...



Cross section of typical Cyclone Steam Separator installation in a large boiler drum.



CROSS-SECTIONAL ELEVATION

B&W Cyclone Steam Separator with section cut away to show functioning.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company — "Bridgeport" BRASS CO. — *Headquarters for BRASS, BRONZE, and COPPER*

Cupro Nickel Condenser Tubing

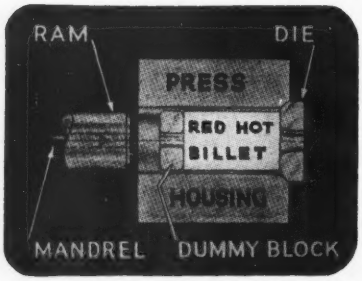
Its Possibilities For Peacetime Use

During the war, the Bureau of Ships specified the use of 70-30 cupro nickel condenser tubes for all battleships and many other types of vessels although both copper and especially nickel were critical metals at the top of the essential list.

The use of 70-30 cupro nickel was based on the results of prolonged tests made under various operating conditions before the war. The Navy had used Admiralty brass condenser tubes for many years until the development of turbine-driven propulsion which necessitated increased speed of the circulating water and caused the Admiralty tubes to fail from air impingement corrosion. Cupro nickel has excellent resistance to impingement attack and also withstands erosion and general corrosion better than brass. Cupro nickel tubing has long been used for feed water heaters because it stands up well under higher operating temperatures and pressures.

Special Equipment Required

The first step in the manufacture of cupro nickel tubes is to cast the alloy in the form of a solid billet approximately 8" in diameter and about 5 ft. long. This is sawed into billets about 9" long which are then heated to redness and extruded to form a tube with a heavy wall.



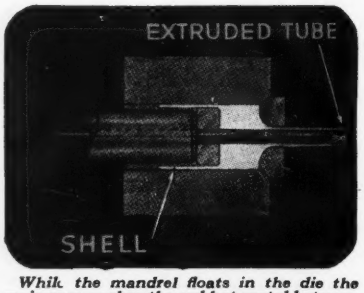
Red hot billet is pushed into the containe of the extrusion press, and is confined by the die at one end and by the dummy block at the other end.

After extrusion the heavy walled tube is brought down to smaller diameter and thinner wall by the tube reducing method which is essentially a rolling operation. This is followed by a number of annealing and conventional drawing operations until the tube is finished to the required dimensions which are generally 5/8" O.D. x .049" wall.

Corrosion Resistance Improved

Although straight 70-30 cupro nickel has fine resistance to corrosion from sea water and to stress corrosion cracking from moist ammonia, oxygen, stress and the time element, investigations conducted in the last five or six years have shown that the addition of a small amount of iron is very beneficial in making it more resistant to all types of corrosion from sea water.

English investigators were first to recognize the advantages of adding about 0.3% to 1% iron and approximately 0.5% manganese. Our own tests conducted at Kure Beach, North Carolina, were published in the Transactions of the Electro Chemical Society, Volume 87, 1945, "Corrosion and Biofouling of Copper-base Alloys in Sea Water," by C. L. Bulow. A copy of this paper is available upon request. The addition of 0.30 to 0.50% iron and 0.50 to 1.00% manganese was found to be distinctly beneficial for retarding impingement, pitting and general corrosion from sea water. The results of our tests are shown graphically in the chart in column 3. As a result, all Bridgeport cupro nickel condenser tubing now contains both iron and manganese as specified by the Bureau of Ships, Specification 44T39 (INT) August 14, 1941.



Whil. the mandrel floats in the die the main ram pushes the red hot metal between the die and the mandrel, forming a heavy walled tube.

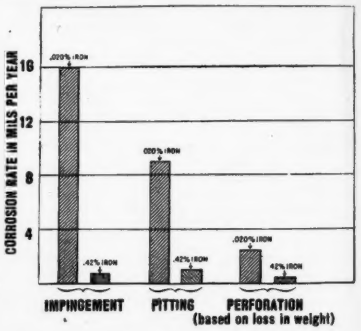
Thermal Conductivity

70-30 cupro nickel has a lower thermal conductivity than brass, consequently some designers provide 10% additional condensing surface as compared to brass to allow a safe margin for this difference. On the other hand, there are some engineers who claim that thermal conductivity has little bearing on the rate of heat flow from one fluid to another through a metal wall. The rate of heat transfer is greatly influenced by the thickness or weight of the corrosion film which forms on the metal after the tube is in service for a period of time. Data obtained on clean tubes are therefore different from data obtained from tubes that have corrosion scale. In the case of cupro nickel, its corrosion film is thinner than the corresponding corrosion film found on brass so that its heat transfer properties remain quite constant.

Outlook for Peacetime Use

Will 70-30 cupro nickel be used more freely in the postwar period? Some engineers are studying its possibilities for use on ocean liners and fast turbine-driven freighters that are either in the blueprint stage or under actual construction. They are thinking of the advantages of using a material which intrinsically has greater endurance and therefore permits greater leeway in operation. They know the advantages of fewer shutdowns, less frequent cleaning, less maintenance, longer trouble-free periods between retubing. They are looking forward to using tubing which can stand severe usage without injury, and can be used at higher operating temperatures and with corrosive waters.

CORROSION RATE OF 70-30 CUPRO NICKEL IN CLEAN SEA WATER
Showing Effect of Iron Content on Corrosion Rate



The selection of the correct condenser tube alloy is still a matter of economics and is definitely related to service conditions. In Bridgeport's Condenser Tube Manual an attempt is made to list the properties of each available alloy. To help still further, Bridgeport's Technical Service Department is ready to serve in the selection of the alloy which will bring the greatest satisfaction.

"Bridgeport" BRASS CO. **BRIDGEPORT BRASS**

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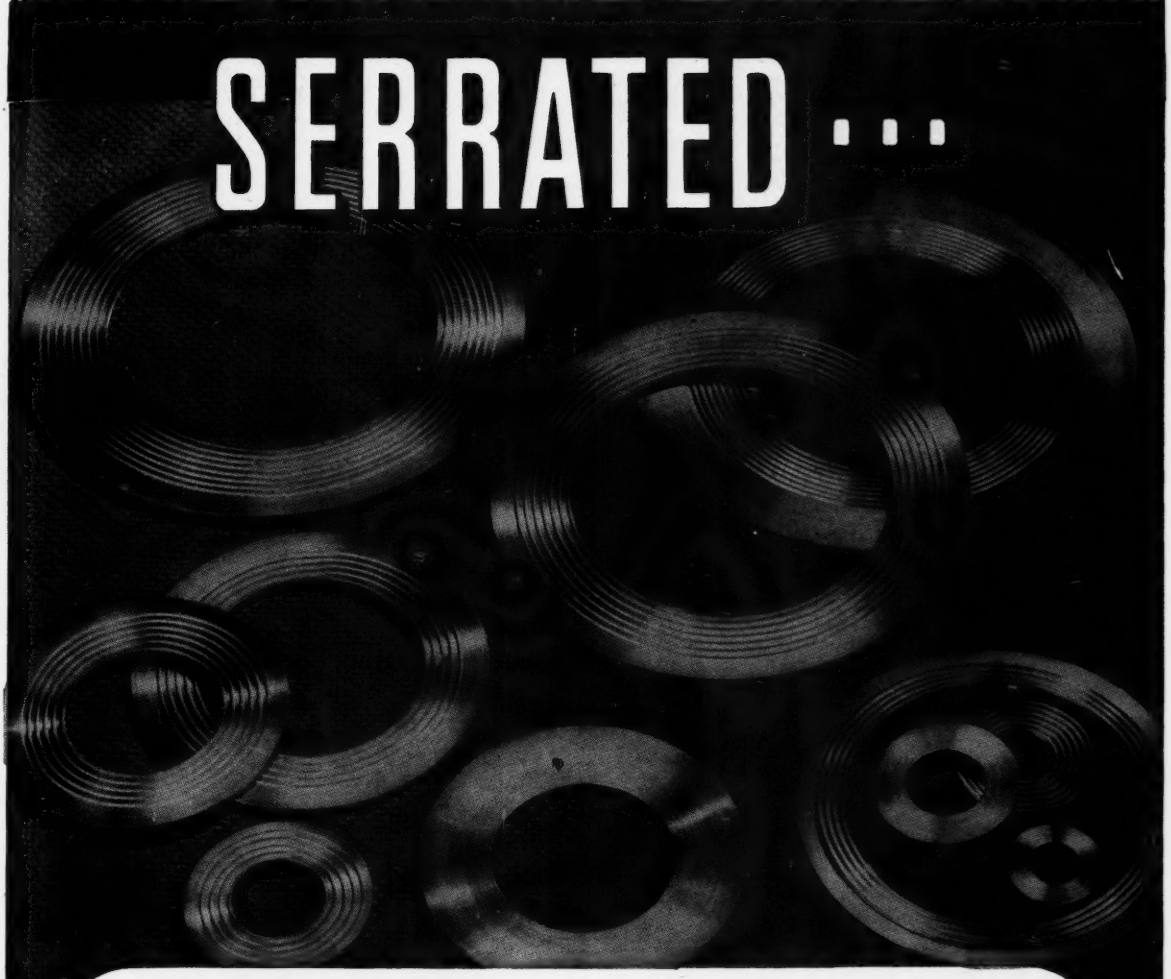
MODERN DEVELOPMENTS OF GASKET RESEARCH

SERRATED . . .



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THIS COMBINATION OF THE *Right* BOILER AND THE *Right* STOKER

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The C-E Spreader Stoker will burn satisfactorily a wider range of coals than any other stoker; for example, the high ash, high volatile coals of the Pacific Coast region, the sub-bituminous coals and lignite of the West, the free-burning clinkering midwestern coals of Illinois, Indiana, Ohio and Western Kentucky and the caking bituminous coals of the East. Poor quality, fine sizing and other undesirable characteristics are all taken in stride by the C-E Spreader—the nearest thing there is to a universal stoker. With a furnace design properly adapted to the requirements of spreader firing, as it is in Combustion's VU Unit, advantage can be taken of whatever low-priced coals the market affords.

The VU Unit as a whole was initially designed to bring central station performance standards to the average plant. That it met this objective is now a matter of record in hundreds of installations. The quality of its design and construction is perhaps best evidenced by its ability to stay on the line for long periods of uninterrupted service. Translated into economic terms, this means maximum protection against direct and indirect outage losses which in many plants can easily be of substantial proportions. It also means low year-in and year-out maintenance. Coupled with the high efficiency characteristic of VU performance, these advantages add up to low overall steam costs, or, to put it another way, high return on investment.

Installations of this VU—Spreader Stoker combination now have an aggregate capacity of more than 2,500,000 lb of steam per hr. Units ranging in capacity from 20,000 to 100,000 lb per hr are in use in a wide variety of processing and manufacturing industries not only throughout the United States but in South America and in such remote regions as Russia and China. Their performance records are your assurance of efficient, dependable operation.

So, unless your steam plant is all that it should be — modern, efficient, reliable and able to cope with almost any fuel situation — plan now for its rehabilitation. As a first step, why not investigate the C-E Spreader fired VU Unit?

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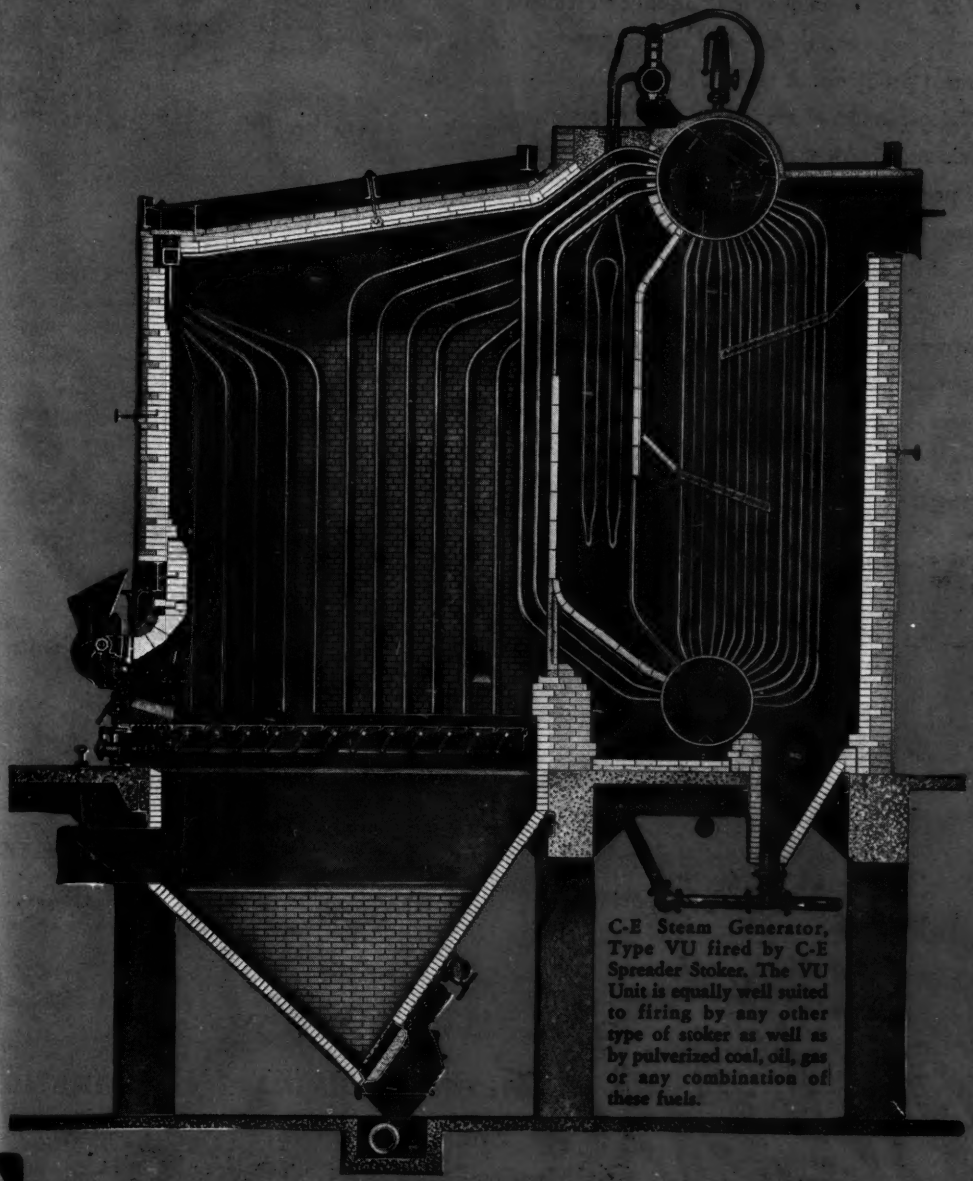
. . . IN HUNDREDS OF PLANTS



C-E Steam Generator, Type VU fired by C-E Spreader Stoker. The VU Unit is equally well suited to firing by any other type of stoker as well as by pulverized coal, oil, gas or any combination of these fuels.

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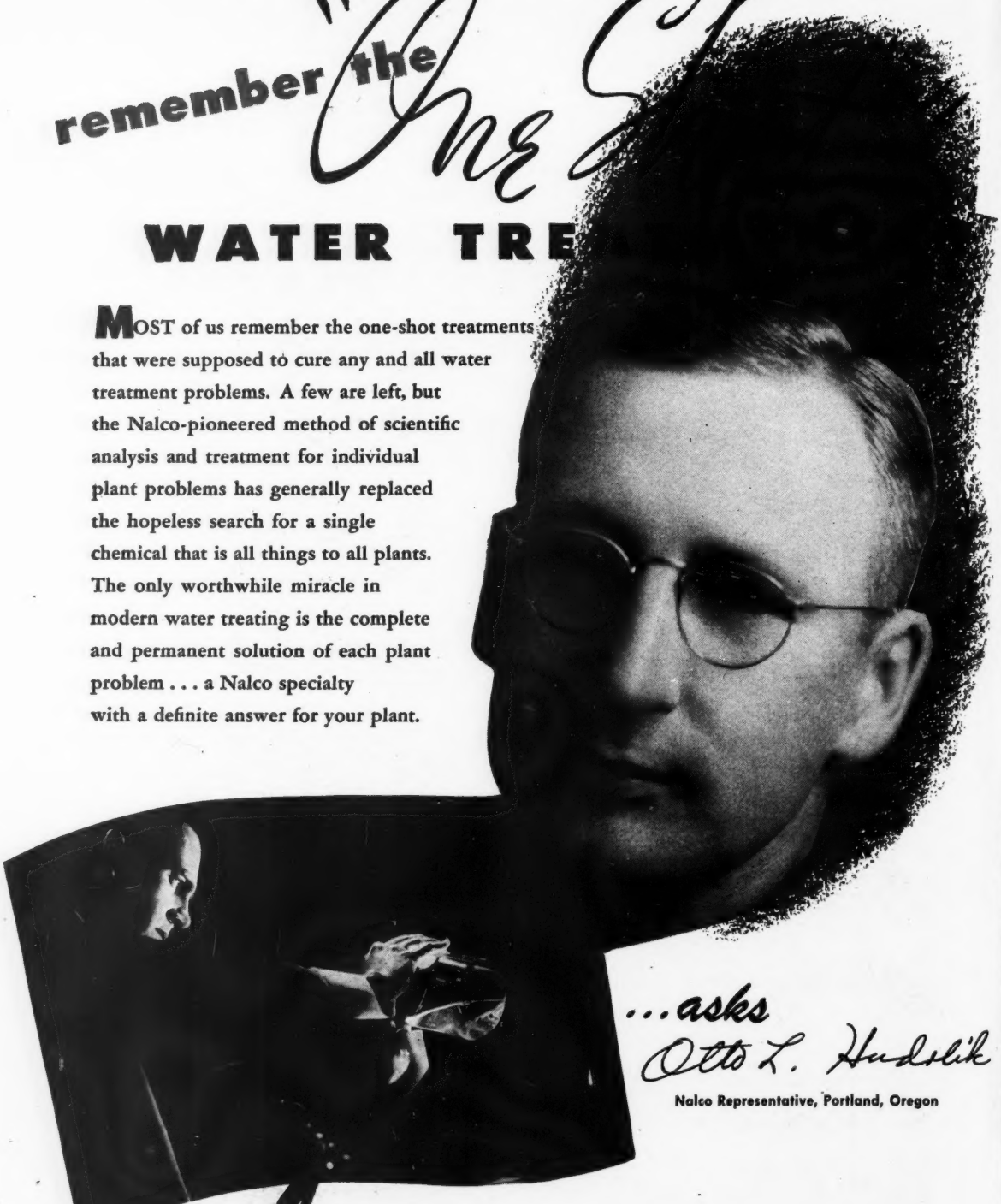

. . . asks Otto L. Hudelik

Nalco Representative, Portland, Oregon

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HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Welded HRT Boilers**—Bulletin issued by Dominion Bridge Co., Ltd., describes principal features of its hrt boilers; provides dimensional tables; shows typical installations in steel mills, dairies, hotels and other plants.

2 **Fly Ash Arrestor**—Bulletin describes the Whirlex arrestor installed in smoke stack or breeching to end fly ash nuisance. Features include: no moving parts, low draft loss, high efficiency. Typical installations are illustrated. Handy charts help in calculation of boiler loads and chimney capacities. The Fly Ash Arrestor Corp.

3 **Fuel Oil Treatments**—Bulletin 455 tells how modern treatment improves atomization and combustion by turning harmful sludge into useful fuel. Gamlen Chemical Co.

4 **Self-Contained Boiler**—Literature tells about the quick steaming, easy installation and easy operation of the Amesteam generator. This self-contained unit requires no foundation or stack, has capacities from 10 to 300 hp. Ames Iron Works.

5 **Refractory Coating**—Illustrated bulletin tells how Brickseal refractory coating prolongs the life of new or old brickwork by preventing disintegration due to cracking, spalling, slagging. Applied with brush or spray gun. Brickseal Refractory Co.

6 **Boiler Seam Protector**—Descriptive bulletin tells how National girth seam protector saves trouble and money by preventing leaks and fire-cracking in new or old seams in boilers. National Boiler Protector Co.

7 **Unit Pulverizers**—Catalog describes operation of S-P unit pulverizers used for firing hrt boilers, water tube boilers, rotary kilns, oil stills, sewage sludge dryers, etc. The Sims Co.

8 **Fuel Oil Heater Handbooks**—The Whitlock Manufacturing Co. has just released a new Bulletin No. 35 featuring its line of fuel oil heaters. Included is a handy viscosity-temperature chart which shows at a glance the temperature required to reduce oil to the desired viscosity; also capacity tables and other handbook data.

9 **Boiler Brick Data**—Folder describes how Carbofrax silicon carbide brick insures greater steaming capacity and reduces boiler outages. Also includes useful engineering data on boiler furnace construction and operation. The Carborundum Co., Refractories Div.

10 **Steamizer Oil Burner**—Bulletin discusses advantages of Steamizer MTB oil burner: gas or steam atomization of fuel oil or sludge, short flame at low excess air, low fuel oil pressure required, low steam consumption. John Zink Co.

ELECTRICAL

11 **Data on Electrical Insulations**—Well-illustrated 12 pg. bulletin describes temperature resistance, thermal conductivity, flexibility, dielectric strength and other properties of Fiberglas. This modern electrical insulation is being used in motors, generators, converters, transformers, hookup wires, cables and other equipment. Owens-Corning Fiberglas Corp.

12 **Portable Infrared Units**—How the Fostoria Infrared lamp is used for baking insulation varnish on small motors, thawing frozen pipes, removing paint, heating oil valves, etc., is described in new bulletin. The Fostoria Pressed Steel Corp.

13 **Prelubricated Ball Bearing Motors**—Bulletin B-3554 and descriptive bulletins 3100-CSP and 3100-1 cover prelubricated ball bearings (for squirrel cage motors of 15 hp and under) that are said to eliminate lubrication for 5 years or more. Westinghouse Electric Corp.

14 **Performance Features of Synchronous Motors**—Recently issued 4-pg. folder No. FF-11 illustrates and describes eight of the economies and operating advantages gained by use of synchronous motors engineered to large, constant-speed industrial applications. Gives examples of synchronous motors direct-connected to various types of drives. Electric Machinery Mfg. Co.

15 **Condensed Motor Catalog**—Gives ratings, sizes, characteristics, dimensions, where-to-use data, and prices of G. E. a-c and d-c motors 1/16 to 75 hp. This boiled down data simplifies motor selections. General Electric Co.

16 **New Power Factor Regulator**—Features of the Haug System power factor regulator are described in a booklet issued by Modern Control Equipment Co. Connected to the lines of commercial power users, this regulator is said to raise the power factor by taking the magnetizing current off the line with a negligible cost in operation. Also, by increasing the power factor, it will reduce the monthly power bill.

17 **Batteries for Stationary Application**—Storage batteries for stationary applications are featured in Catalog No. 1000 recently published by Gould Storage Battery Corp. Details and illustrations are given on the Gould Plante, Kathanode Glassklad and Dreadnaught. Various characteristic discharge curves are shown and technical data is furnished covering all sizes and types used in stationary applications.

FANS, PUMPS, COMPRESSORS

18 **Turbine Well Pump Performance**—Reprinted article entitled "Influence of Ground-Water Level on Turbine Well Pump Performance," by P. J. Equi, is now available. Author explains loss in output caused by receding level; offers a remedy for the condition. Worthington Pump & Machinery Corp.

19 **Removable Pump Liner**—New Blackmer Bulletin No. 307 carries for the first time a comprehensive illustration and description of the new type of removable liner which is now standard construction in Blackmer power pumps. Contains list of liquids handled; typical installation photographs. Blackmer Pump Co.

20 **Positive Pumping Without Pulsation**—Book No. 20 tells how rotary motion in the R&M Moyno pump creates a continuous flow at positive pressure. Its ability to pump virtually everything from free-flowing liquids to non-pourable pastes makes this pump popular in the food, chemical, ceramic, plastics, paint, brewing and many other industries. Robbins & Myers, Inc..

21 **Spotting Air Where Needed**—Bulletin C-5 describes Fuller rotary air compressors; shows how these compressors, "spotted where you need the air," elim-

22 **Definitions and Test Data on Fans**—The National Association of Fan Manufacturers has just issued a new publication entitled "Standards, Definitions, and Terms in Use by the Fan and Blower Industry." Consolidates in one publication all of the standards generally recognized and accepted by the industry. For clarification, terms, definitions, and abbreviations are also included.

23 **Vibration-Free Pumping**—Catalog 1-127-G gives construction and operating details of IMO pumps for the quiet, vibration-free handling of oils and other liquids at all capacities and pressures. Imo Pump Div., De Laval Steam Turbine Co.

24 **Single-Stage Service Pumps**—Ingersoll-Rand Co. announces a new 20-pg. catalog covering the design, construction, and engineering details of its Cameron Single-Stage general service pumps. Applications include condenser circulation, air conditioning equipment, transfer service in sugar refineries, chemical plants, oil-tank farms, beverage plants, food-packing plants and many other industrial hydraulic requirements. Designed for capacities to 25000 gpm, against heads up to 300 ft. Considerable space is devoted to performance and dimension tabulations, and catalog is rounded out with steps in the solution of a typical pumping problem.

INSTRUMENTS AND CONTROLS

25 **Cathode-Ray Oscillograph**—New folder describes features of the Du Mont Type 248 Cathode-ray oscillograph for accurate observation and study of microsecond pulses containing frequency components as high as 10 megacycles. Now available without priority. Allen B. Du Mont Laboratories, Inc.

26 **Flow Rate Measurement**—Bulletin 45-A gives details of Master Enclosed Rotameter for normal pressures and temperatures; the Armored Rotameter for high pressures and temperatures; meters for recording, controlling and totalizing rates of flow; meters for very low flows and those for extremely large flows; Laboratory Rotameters and others. Contains two pages of helpful engineering recommendations for types of Rotameters and materials of construction to be used in measuring the flow rates of a great many difficult and corrosive fluids and gases. Fischer & Porter Co.

27 **Feed Water Control for High-Duty Boilers**—Bulletin No. 441 discusses characteristics, features, typical results had with Copes feed water control for high-duty boilers. Contains schematic drawings in color of Copes system in operation. Northern Equipment Co.

28 **Electronic Feed Water Control**—How the Fireye control maintains desired water level electronically, instantly cuts off fuel supply and sounds alarm at low water level are described in new Bulletin 103-C. Includes installation photos and specifications. Combustion Control Corp.

29 **Bristol Publishes New Catalog**—A new general catalog entitled, "Specification Index for Bristol Instruments," has been published by the Bristol Co. Contains 24 pgs. of information on the Bristol line of automatic controlling, recording, and indicating instruments and gives hints on how they can be used effectively to save time, and money and promote efficient operation. Specification data is given on each instrument listed.

(Continued on page 176)

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MARCH 1946

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30 **Pressure Operated Switches**—New catalog tells about Starbird pressure operated switches, designed to give continuous control from 30 in. of vacuum to 5000 psi. Automatically start or stop pumps, motors, warning devices, valves, etc.; used with gas, steam, oxygen or oil systems. Meletron Corp.

31 **Pressure Regulating Valves**—A new Pressure Regulating Valve Catalog No. 155 has just been released covering the Strong line of direct operated and pilot operated spring loaded valves for steam, air and gas service with sizing information. Also describes a new fabricated steel separator of advance design with important facts on sizing both separator and trap for automatic drainage. Strong, Carlisle & Hammond Co.

32 **Catalog Shows Foxboro Instruments**—The Foxboro Co. has just issued Catalog 370, presenting the company's full line of recording and indicating instruments for measurement and control. Arranged for quick reference, and profusely illustrated, the sections deal with instruments for temperature applications, pressure, humidity, flow, liquid level, density, and other process variables. Control valves, planimeters, instrument accessories and supplies are included. Also describes Foxboro's line of Dynalog electronic instruments.

33 **Regulator Data Book**—Data Book No. S-13 describes sensitivity, power, speed and stability of Republic regulators; lists typical applications in power stations and process plants; contains useful engineering information. Republic Flow Meter Co.

34 **Temperature Control Instruments**—New, 16 pg. catalog describes the complete H-B line of temperature control instruments which include relays—mercury plunger and sensitive types—thermostats and Red-Top thermo-regulators. These instruments are designed to maintain any holding points of range levels, as specified, between minus 30 deg. F. and 500 deg. F., with a sensitivity of within 1/10 of 1 deg. F. of the specified control points. Used for controlling constant temperature of ovens, heating baths, refrigerants, incubators, etc. H-B Instrument Co.

MAINTENANCE MATERIALS

35 **Portfolio of Sealing Materials**—Free portfolio describes advantages of synthetic sheet gasket materials for use with oils, chemicals, extreme heat or cold and high compression. Also contains over 50 samples of Fel-Pro gaskets and packing materials with hints on their specification and application. Felt Products.

36 **Lubrication Handbook**—Well-illustrated service handbook describes Lubriplate lubricants and their application on shafts, ball and roller bearings, chain drives, gears and other machinery. Also tells how to use Lubriplate for rust proofing engine parts, piping, fittings, tanks, etc. Fiske Brothers Refining Co.

37 **Packing Selection Handbook**—Collins double-lip packings, asbestos caustic packings and many other pressure seals are described in 24 pg. catalog. Contains packing and gasket recommendations for pumps, compressors, turbines, expansion points, heat exchangers and other equipment. Collins Packing Co., Inc.

38 **All-Purpose Thermal Insulation**—High insulation efficiency, rust resistance, easy application, coverage and other features of B-H No. 1 insulating cement are discussed in new folder. Shows chart for figuring yearly savings on piping, valves, drum ends, etc. Baldwin-Hill Co.

39 **How to Lubricate Gun-Pakt Expansion Joints**—Recent issue of Yarway News contains useful hints on how to lubricate Yarway Gun-pakt expansion joints; also carries terse reports on what users say about impulse steam traps. Yarnall-Waring Co.

40 **Vacuum Cleaning Equipment**—Literature describes use of Hoffman stationary vacuum system or heavy-duty portable cleaner to remove coal and ash deposits. Tells how better dust control protects delicate instruments, insures safer and more profitable plant operation. U. S. Hoffman Machinery Corp.

41 **Oil Purifier**—Bulletin No. 400 points out that water is usually chief trouble-maker in turbine oil lubrication; explains how a De Laval oil purifier, by centrifugal force, continuously removes condensate or other water at time it removes dirt. The De Laval Separator Co.

42 **Aluminum Paint Use-Indicator**—A new, handy, pocket-size aluminum paint indicator is being offered by Crescent Bronze Powder Co. One setting of indicator tells: (1) How to prepare any given surface before applying the paint; (2) how many square feet of any given surface can be covered with a gallon of the paint; (3) the kind of structures having the given surface, which is covered in detail for each possible surface on which aluminum paint can be applied. Indicator has two sides . . . one side for interior applications, the other for exterior applications.

43 **Industrial Cleaning Service**—Bulletin tells about the development of Dowell chemical method for removing water- or steam-deposited sludge and scale from all types of industrial equipment. Lists actual results of this cleaning service in boilers, condensers, water lines, economizers, distillery, blast furnace. Contains typical hookup diagram. Dowell, Inc.

44 **Chemical Resistant Paint**—Complete information on the new Pen-Kote 500 chemical-resistant maintenance paint is given in an illustrated bulletin announced by Peninsular Chemical Products Co. Illustrations of typical jobs show how this quick-drying, odorless protective coating is readily applied to heated, wet, and porous surfaces of all kinds. Unretouched photographs of test strips demonstrate the protection provided by a single coat of Pen-Kote 500 against hot acids, alkalis and water; and other distinctive features are explained in detail.

MECHANICAL TRANSMISSION

45 **Auomatic Clutch Folder**—Salsbury Motors, Inc., announce Bulletin No. 4501 describing in detail their new automatic clutch. Designed for operating loads up to 6 h.p., this clutch operates smoothly and easily, absorbs momentary overload, eliminates starting shock and arrives quickly at driving speed.

46 **V-Belt Handbook**—New 384 pg. handbook explains how Dayton V-belts eliminate vibration and trim maintenance costs; gives complete engineering data and tables for figuring quickly any power transmission drive. The Dayton Rubber Manufacturing Co.

47 **Magnetic Adjustable Speed Drive**—Recently issued is a 16-pg. Booklet No. 183, printed in three colors, with factual data and 40 illustrations covering the E-M magnetic adjustable-speed drive for boiler draft fans, centrifugal pumps, centrifugal blowers and compressors, and other loads where torque required decreases with reduction of speed. Principles of operation, performance characteristics, and applications are described and illustrated.

48 **Latest Data on Gears**—New Abart Bulletin, in colors, contains the latest gear engineering data. It deals with spur, bevel, worms, helical, internal, worm wheels, spiral, sprockets and racks, precision cut of any gear material. Illustrations and summary of the Abart speed reducers are also included. Abart Gear & Machine Co.

PIPING, VALVES, FITTINGS

49 **Pipe Bending Machine**—Folder describes "American" machines for bending cold pipe, conduit and tubes into all shapes. Hand operated capacities ¼ to 6 in.—motor operated ¾ to 8 in. American Pipe Bending Machine Co., Inc.

50 **Streamlined Pressure Reducing Valve**—Bulletin 962 features the Cash streamlined type 1000 pressure reducing valve; points out why you get no turbulence and can meet peak demand at all times. Also explains why straightline flow gives maximum capacity, close delivery, tight closure. A. W. Cash Co.

51 **Pipeline Strainers**—How Yarway fine-screen strainers are used to prevent rust, scale and dirt from clogging steam traps, reducing valves and other pipe line equipment is explained in Bulletin S 201. Also gives prices, weights and dimensions of the strainers. Yarnall-Waring Co.

52 **Corrosion Resistant Valves**—Data sheet describes new Aloyco 20 valves, fabricated of an alloy resistant to sulphuric acid in a broad range of concentration and temperatures. Alloy Steel Products Co.

53 **Hose Fittings**—A new catalog section on its lines of hose fittings, including couplings, joints clamps, washers, nozzles, nipples and flanges has just been published by The B. F. Goodrich Co. Featured are instruction for properly attaching couplings, and other types of fittings which add to service life and make the hose safer.

54 **Help on Drainage Problems**—Reference Catalog 444 explains the design and application of Nicholson traps for every power and process purpose; offers helpful suggestions on drainage problems. W. H. Nicholson Co.

55 **Air Line Filters**—New 44-page catalog tells about operation of Model AAPHS pipe line filter as a final stage in protection of delicate pneumatic control instruments. Also describes entire Staynew line, including filters for building ventilation, pipe lines, engine and compressor intakes. Dollinger Corp.

56 **Safety and Relief Valves**—Safety and relief valves to match the improved designs of the latest power and process equipment are announced in a catalog, No. 45, just issued by the Farris Engineering Co. An easy-to-use pictorial index shows line drawings of all the basic Farris valve types. With this index a valve user can pick out the valve he needs without having to thumb through a whole catalog. Directly opposite the pictorial index is a detailed index showing what the valve can be used for and where to find its specifications in the catalog.

57 **Steam Trap Handbooks**—Catalog H contains tables, charts, diagrams and rules for selecting traps, giving complete explanations, make the new 36-page book a handy reference volume for every engineer's library. Armstrong Machine Works.

58 **Plastic Coating for Pipes**—Illustrated circular tells how plastic cork coating insulates and adds years of life to pipes and other metal surfaces by preventing rust and corrosion. Stops condensation drip. J. W. Mortell Co.

59 **Threadless Pipe Fittings**—New catalog describes features and applications of Flaggseal fittings for making Silbraz joints. These fittings and flanges have ring of silver brazing alloy. When heated with oxyacetylene torch, this alloy melts and flows between pipe wall and bore of fitting, making tight joint. Catalog contains dimensions and useful working data. Stanley C. Flagg & Co., Inc.

WATER TREATMENT

60 **Scale and Corrosion Control**—A reprinted article "Scale and Corrosion Control in Portable Water Supplies at Army Posts" describes a series of tests carried out to determine the effectiveness of various chemicals. Contains many illustrations and charts. National Aluminate Corp.

61 **Cleaning Rusted Steam Lines**—Bulletin tells how Coravol helps prevent corrosion in steam and condensate lines; cleans out rust deposits resulting from previous corrosion. Coravol volatilizes and condenses with steam, circulates through entire system. Western Chemical Co.

62 **Algaecide for Cooling System**—Illustrated Bulletin O-15 describes Santobrite algaecide, which maintains cooling tower efficiency by preventing sluggishness and obstructions in circulating system. No special equipment required. Organic Chemical Div., Monsanto Chemical Co.

63 **Case History on Slime Removal**—How W & T chlorination was used to remove slime in heat exchangers of southern refinery and showed a power saving of 3,300,000 kw. hr. is covered in recent case history folder. Wallace & Tiernan Products, Inc.

WELDING

64 **Data on Arc Welding Electrodes**—The Hobart Brothers Co., has released a strip folder announcing their complete, post-war line of arc welding electrodes. This handy pocket-size folder furnishes description, application, procedure, physical properties of deposited metal, sizes available for each type electrode in this new post-war line, other useful data.

(Continued on page 176)

CRANE

NEW PRESSURE-SEAL BONNET VALVES

A new line . . . a basically different design . . . of welding end gate, globe and angle, and automatic stop check valves . . . featuring new adaptability to high pressure and high temperature services . . . in pressure classes up to 1500 pounds.

Here you see the latest advance in on-the-job valve efficiency . . . the Crane Pressure-Seal Bonnet principle. Note the absence of the customary flanged bonnet joint. The joint is inside . . . automatically sealed by pressure in the valve. Bonnet joint leakage and maintenance are eliminated.

The lighter weight of these valves . . . 40 to 60% . . . and greater compactness over conventional designs, reduces handling and piping erection costs. Their streamlined construction includes new achievements in straight-through flow . . . smooth operation . . . and trouble-free performance.

Extensive field tests under severe working conditions record the all-round superiority of Crane Pressure-Seal Bonnet Valves. We'll be glad to give you all the facts. CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill. *Branches and Wholesalers Serving All Industrial Areas*

NEW
NEW
SIMPLIFIED YOKE—Yoke is firmly mounted on body with simple clamp. Forces required to operate valve are transmitted direct to body.
PRESSURE SEAL BONNET JOINT—Pressure of fluid seals the new Crane bonnet against leakage. Conventional flanged joint is eliminated.
EASE OF INSPECTION—New simple construction of Pressure-Seal Bonnet. Opened and re-assembled in far less time than flanged bolted bonnet.
LIGHTER WEIGHT VALVES—Compactness of design permits 40 to 60% weight saving. Conserves space; simplifies piping erection and suspension.
FULL LENGTH DISC GUIDE—Close fit machined guide insures true disc travel all the way. Full guiding where needed—near point of seating.
BETTER INSULATION Streamlined exterior design makes application of insulation easier; saves time and material; gives neater appearance.
NEW FLEXIBLE WEDGE DISC—Built-in flexibility keeps disc from sticking. Self-adjusting to temperature changes in valve body and pipe line strains.
NEW TYPE BODY SEAT RINGS—Permit straight-through flow with minimum friction. Rings are welded-in. Stellite facing insures highest wear resistance.
CRANE STEEL

(Cross-section and exterior of 8 in. 1500-pound gate pattern.)

PATENTS
2029606
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EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

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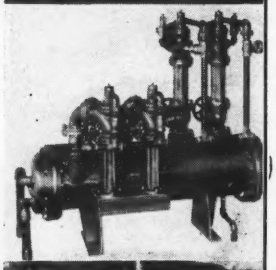
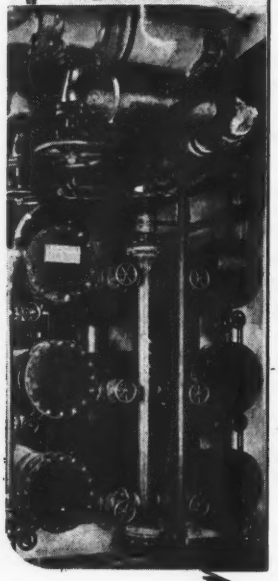
FOR EVERY PIPING SYSTEM

CONSECO



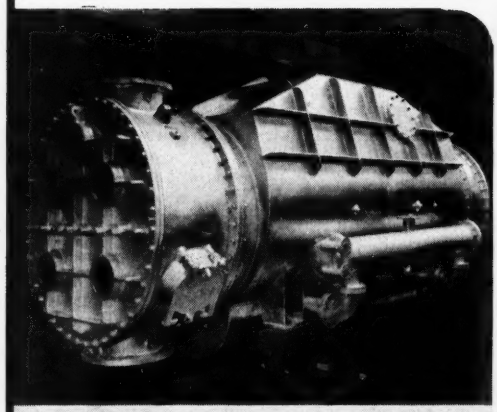


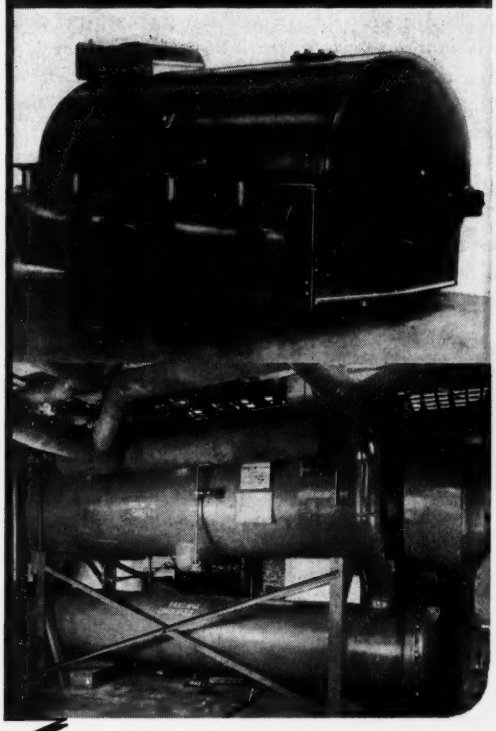
MAINTENANCE SERVICE

Conseco maintains a highly-trained service organization equipped with special tools developed by us to save time, labor and material, ready for action any time of day or night. Condensers, lube oil coolers and other heat exchange equipment are retubed or repaired in the shortest possible time. Years of intensive specialization in retubing work assures best results at lowest cost. Tube sheets, tubes, ferrules, metallic, fibre or corset lace packing, and other necessary materials are always stocked, ready for instant shipment.

Conseco maintains the most modern facilities for calibrating and repairing instruments. Other services include lead coating to increase service life of copper main injection pipe and circulating pump housings, and metallizing to build up worn or broken parts.

The keynote of our service organization is dependable, accurate, *FAST* service performed by competent, properly equipped men working under qualified engineering supervision. Why wait for an emergency? Write for details of our service now .





DEPENDABLE
ACCURATE
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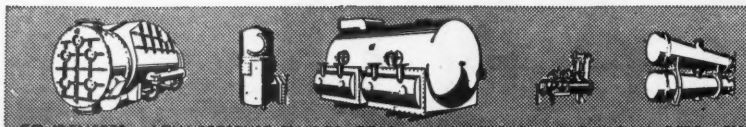
A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

CONDENSER SERVICE & ENGINEERING CO., INC.

71 RIVER ST., HOBOKEN, N. J. **Phone HOboken 3-4425** **After 6 P.M. or Sundays - HOboken 3-4428**



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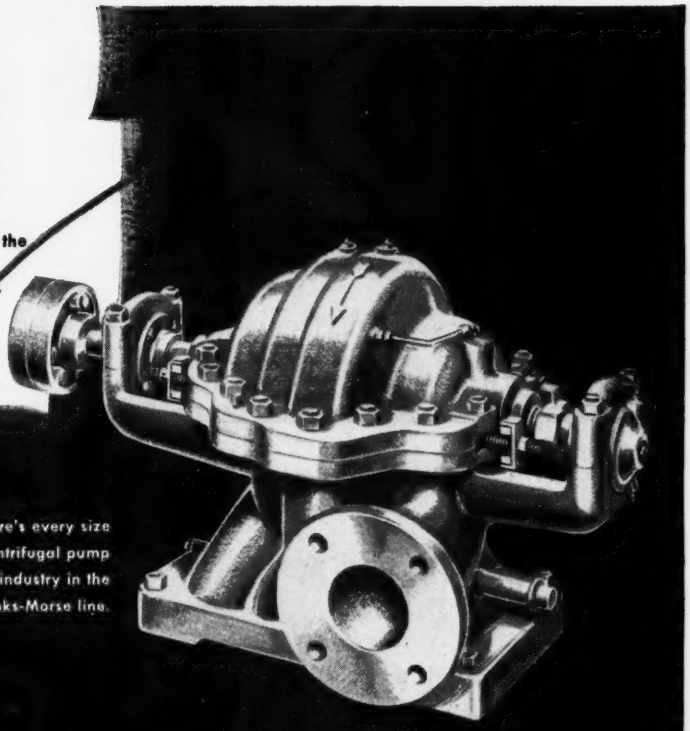
TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

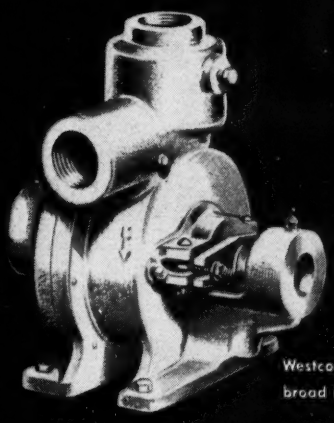
Can ANYONE Make a Pump?

Well, there's no law against it—except perhaps the "law of survival." It's a question of what *kind* of pump you want—and how *good* you want it to be. If you want a pump that will squeeze the last fraction of a cent in value out of the monthly power bill, that is designed to the very limits of hydraulic knowledge—built with the fine tools and complete facilities that such precision design requires—you'll want a Fairbanks-Morse pump.

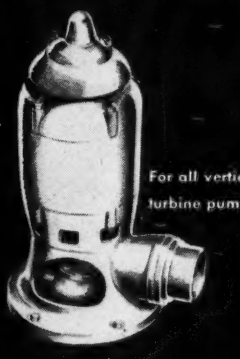


There's every size and type of centrifugal pump used in industry in the Fairbanks-Morse line.

WHEN YOU BUY a Fairbanks-Morse, Pomona or Westco pump, you get a design which is the result of accumulated years of research in not only our own laboratories but those of the universities' scientists whom we have retained!



Westco pumps: precision-built, broad in application.



For all vertical turbine pump work—the Pomona line.

THIS DESIGN and unlimited manufacturing facilities, which only the largest pump manufacturers can offer you, combine to give you pumps superior in performance and reliability.

ANYONE CAN MAKE A PUMP—perhaps! But for *proved* value, *skilled* service—regardless of the type of pumping requirements or the amount of liquid to be moved—Fairbanks-Morse is an unquestioned leader. Call your nearest Fairbanks-Morse distributor or branch office.

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A name worth remembering

DIESEL LOCOMOTIVES · DIESEL ENGINES · MAGNETOS · GENERATORS · MOTORS · PUMPS
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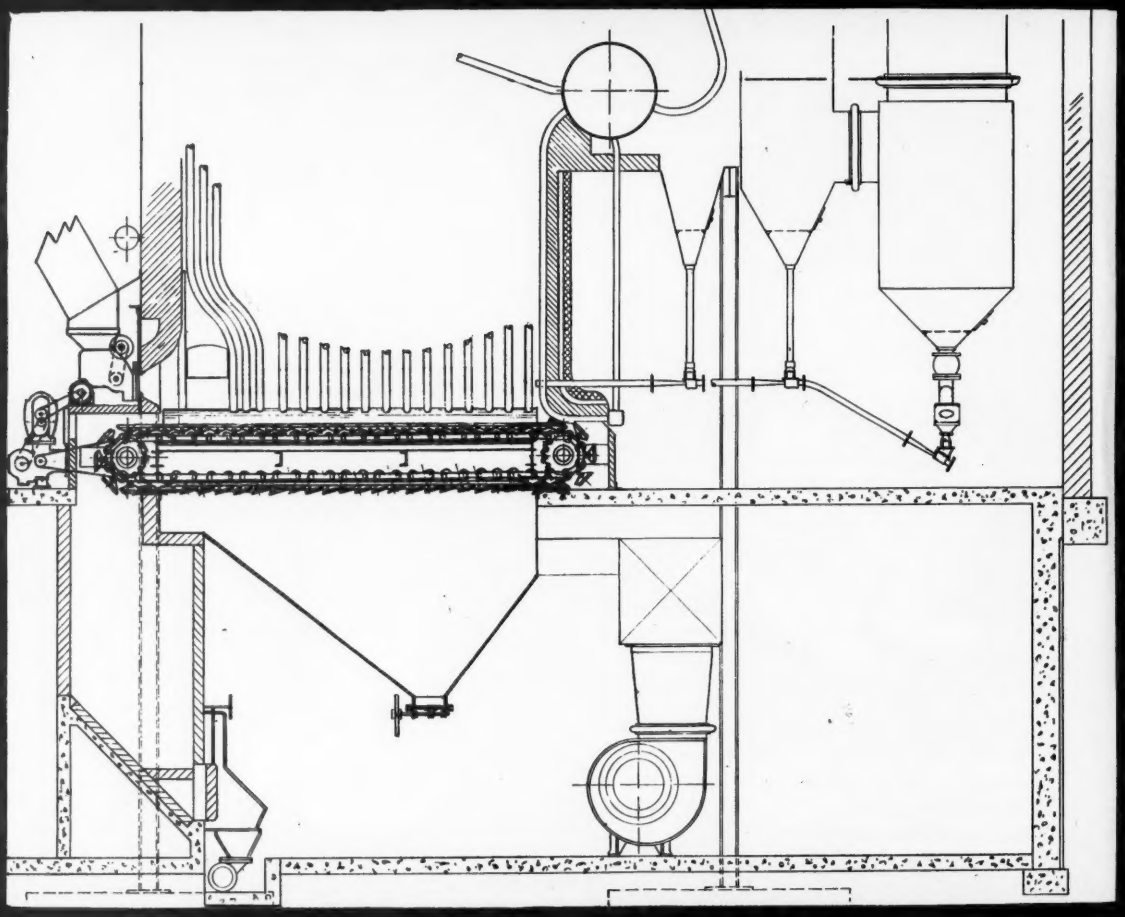
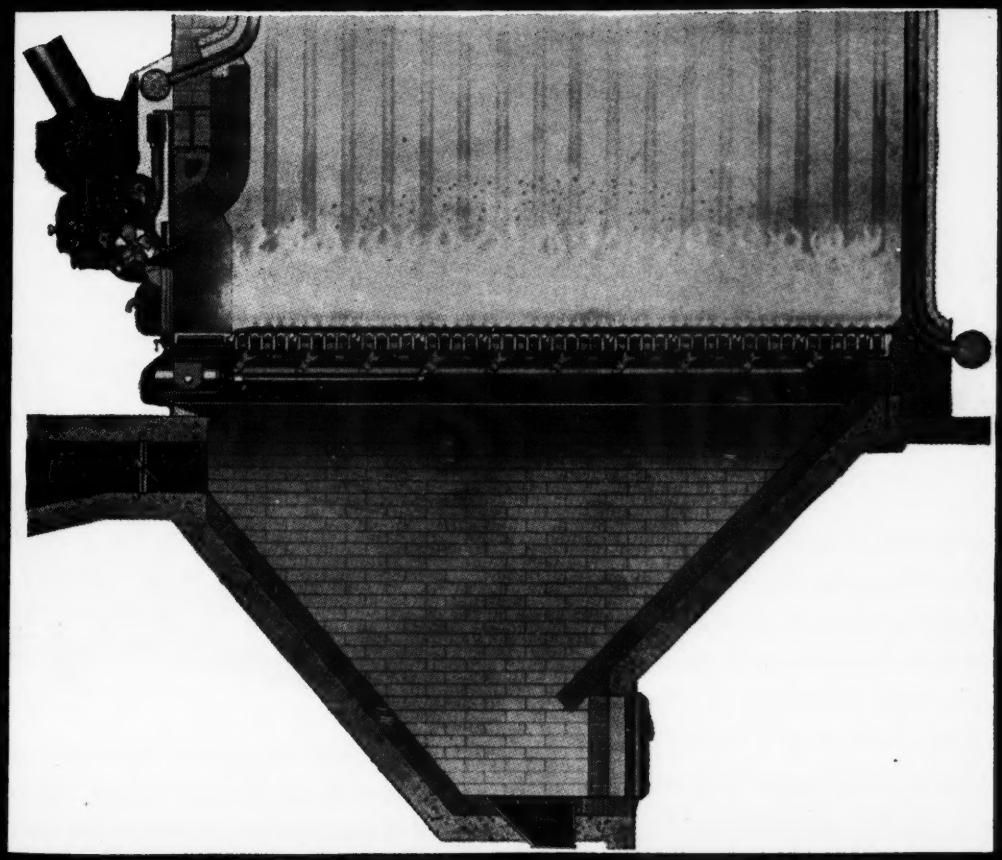
HOFFMAN



HOFFMAN COMBUSTION

WORKS AT: FAIRMONT, WEST VIRGINIA
DETROIT, MICHIGAN

STOKERS



ENGINEERING COMPANY

OFFICES: Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
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IT TAKES MORE THAN SPIRAL WINDING TO MAKE A GASKET...

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Spiral-wound gaskets represent the logical approach to difficult sealing problems—BUT there's much more to it than this. Only in Flexitallic — the *original* spiral-wound gaskets — do you benefit from exclusive precision methods that permit winding to exacting tolerances which cannot be equalled elsewhere in the industry. Only in Flexitallic Gaskets do you get design that is specifically balanced with specific fitting and service requirements.

And only through individually engineered construction and exclusive patented features can you be assured of the dependable, trouble-free service for which Flexitallic Spiral-Wound Gaskets have been famous for over a third of a century. Write for catalog.

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GASKET COMPANY
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THE ANSWER TO 1001 DIFFICULT GASKET PROBLEMS

Guaranteed for the life of your turbine ...and longer

for 18 years

NONPAREIL
TURBINE OIL

... 18 years' experience with an inhibited turbine oil makes it possible to guarantee Nonpareil indefinitely against excessive acidity

Nonpareil Turbine Oil has been in use by turbine operators for 18 years. Original "fills" of oil are still operating, either in the turbines in which they started or in newer units. That's because Nonpareil Turbine Oil is *guaranteed for the life of a turbine.* But more than that, it can be taken from one turbine after years of service, put into a newer unit, and again it will be guaranteed for the life of the new turbine. In effect, Nonpareil lasts forever.

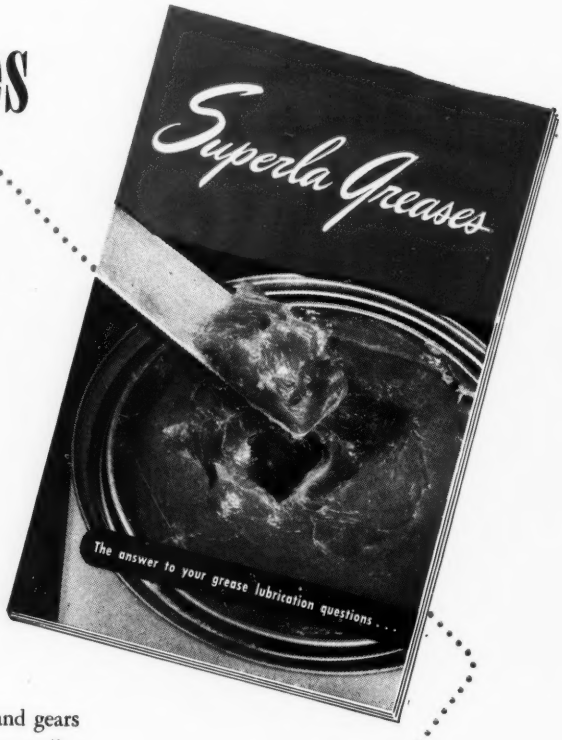
Here's what this means to you. Once installed, Nonpareil eliminates all cleaning of turbine oil systems. It eliminates the need for removing and treating or resting oil. It eliminates the hazard of high oil acidity and the attendant deposit formation and poor oil demulsibility.

Switch to Nonpareil—an oxidation and corrosion inhibited oil with an 18 year record for reducing turbine oil maintenance. A Standard Oil Lubrication Engineer will be glad to discuss with you the Nonpareil guarantee and its many advantages. Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

What qualities to look for in cost-saving greases



QUALITIES that reduce wear on bearings and gears . . . that stop excessive consumption . . . that cut oiler time for servicing equipment . . . these are the qualities you want in a grease. What they are and how you can get them is described in a booklet illustrated at right.

Many of the advantages, which you would expect to find only in special purpose, premium priced greases, are available in a line of 11 grades—including high-temperature greases—called

SUPERLA GREASES

Send for this Booklet

It tells how the most desirable qualities have been incorporated in a complete line of grease to reduce costs on a wide range of Industrial application.

It also has hints on hand packing anti-friction bearings and avoiding over-lubrication.

You can get a copy from the Standard Oil Industrial Service Representative who calls on you or by writing Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

Compare these Springfield PLUS VALUES

. . WITH THOSE OF ANY OTHER BOILER!

- **Staggered Tube Arrangement.** Hot gases cannot stratify or blow through without contacting the tubes. The staggered 4-tube grouping assures good heat transfer.
- **Use of Smaller Tubes.** Springfield's 3" tube groups break the water into more responsive, more efficient units. Result: Easier response to rapid load changes, higher heat transfer efficiency.
- **Electric Furnace Steel Headers.** Stronger, tougher Springfield headers of electric furnace cast steel mean more reliability, lower maintenance requirements, longer life, and saving in erection time.
- **Sectional One-Piece Baffles.** Prefabricated in the shop, with cross-tube baffles shop-assembled with the sections, Springfield baffles are permanently tight and long lasting. Result: Lower maintenance costs, saving in erection time, and higher operating efficiencies.
- **Close-Spaced Water Walls.** Adequate water cooling with bare tubes on close centers assures proper furnace temperatures, minimizes slagging, lowers maintenance and increases the reliability and life of the unit.

Compare the money and fuel saving features listed at the right with those of any other boiler. For complete information on all of Springfield's pioneering developments, and what they can mean to you in quick steaming, easy operation, low operating costs, and high efficiencies, write:

SPRINGFIELD BOILER COMPANY 1951 **Capitol Avenue**
Springfield, Illinois

SPRINGFIELD BOILERS

SPRINGFIELD

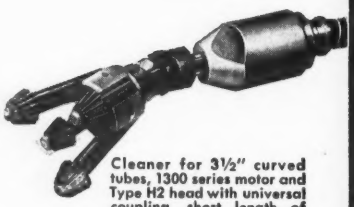
STEAM GENERATING UNITS
ANY SIZE — ANY FUEL — ANY PRESSURE

Here's GOOD HEALTH for boilers

For curved tubes a short-bodied 1300 series motor is used with universal joint between motor and Quick Repair head and a short length of hose at the rear to give flexibility.

Write today for the Elliott boiler tube cleaner bulletin. If you have an unusually tricky or difficult tube cleaning problem, consult with the nearest Elliott specialist. We will put you in touch.

The 1300 series motor connected to Type PN cutter head for 3" straight tubes



Cleaner for 3½" curved tubes, 1300 series motor and Type H2 head with universal coupling, short length of hose at rear of motor.

1300 series cleaner for 3" curved tubes with universal joint and drill, short length of hose connected to rear of motor.

1300 series motor equipped with vibrator head for use in removing scale from the outside of fire tubes.

Y-241

Elliott 1300 series tube cleaners are the speedy remedy for that tired feeling in scaled up boilers.

They have *power*—plenty of it, to drive cutter heads in a smashing attack on the toughest scale, at all the speed required to get a complete cleaning job in a *single pass* through each tube. No need to run the motor while the cleaner is being returned through the tube—simply haul it back and get going on the next tube without delay.

Elliott 1300 series cleaners have everything that years of veteran experience can supply to make the tube cleaning job easier, faster, more thorough.

Avoid that "tired feeling" in your boiler room personnel, too. Tube cleaning is a chore—but its unpleasant features can be greatly reduced. These Elliott 1300 series cleaners are proving it every day.

ELLIOTT COMPANY
TUBE CLEANER DEPT., SPRINGFIELD, O.
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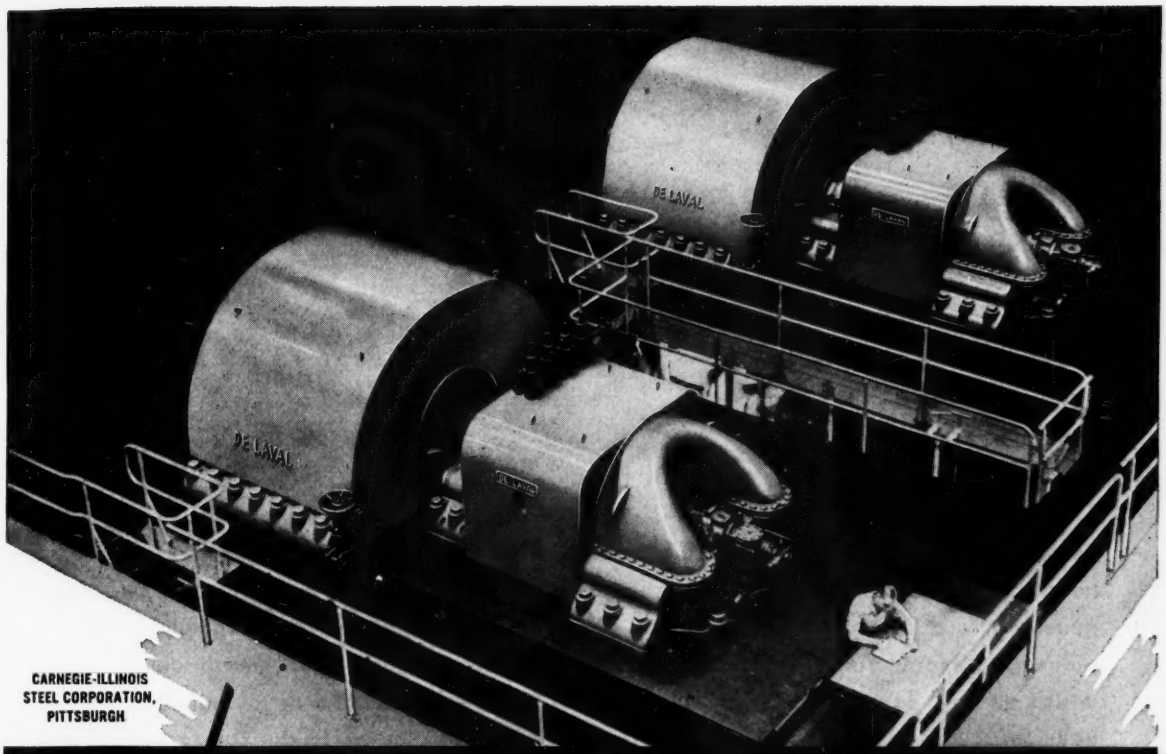
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, O. • NEWARK, N. J.

ELLIOTT 1300 SERIES TUBE CLEANERS



CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH

WORLD'S RECORD BROKEN AGAIN!

by FURNACE EQUIPPED WITH DE LAVAL BLOWERS

For the second time in two years, the world's record has been broken for pig iron production from a single furnace served with De Laval turbine-driven blast furnace blowers.

During the month of July, 1945 the No. 2 Furnace of the Edgar Thompson Works of the Carnegie-Illinois Steel Corp. produced a record-breaking 50,590 tons.

The De Laval blowers at the Edgar Thompson Works, with a capacity of 97,800 c.f.m. against 30 p.s.i., were designed for the highest maximum steam pressure (700 p.s.i) and temperature (825 F.) ever used for this service.

CONSULT THE DE LAVAL STEAM TURBINE CO. FOR CENTRIFUGAL BLOWERS AND COMPRESSORS OF ADVANCED DESIGN.

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TURBINES • HELICAL GEARS
WORM GEAR SPEED REDUCERS
CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS and COMPRESSORS • IMO OIL PUMPS

DE LAVAL

STEAM TURBINE COMPANY · TRENTON 2, NEW JERSEY

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investment in experience...

Components of the MODERN STEAM GENERATOR

milestones . . . In forty-seven years' service to the power industry solving problems of steam generation, Foster Wheeler has brought development of pulverized fuel systems and the three heat-absorbing surfaces of the modern steam generator to a high degree of operating efficiency . . . Continuous research and pioneering engineering have created a background of technical *know-how* upon which all new developments have drawn, and to which each new development has contributed . . . Net result of this backlog of experience has been the constant improvement in the design of high-pressure, high-temperature steam generators.

PULVERIZERS—The first pulverizers to gain commercial acceptance were developed in 1898. Since then the basic design has undergone progressive improvement so that today low-grade anthracite may be successfully used as fuel. Development reached a peak in the record-setting availability mark of 99% established by Foster Wheeler ball mills using coal of 50—55 grindability.

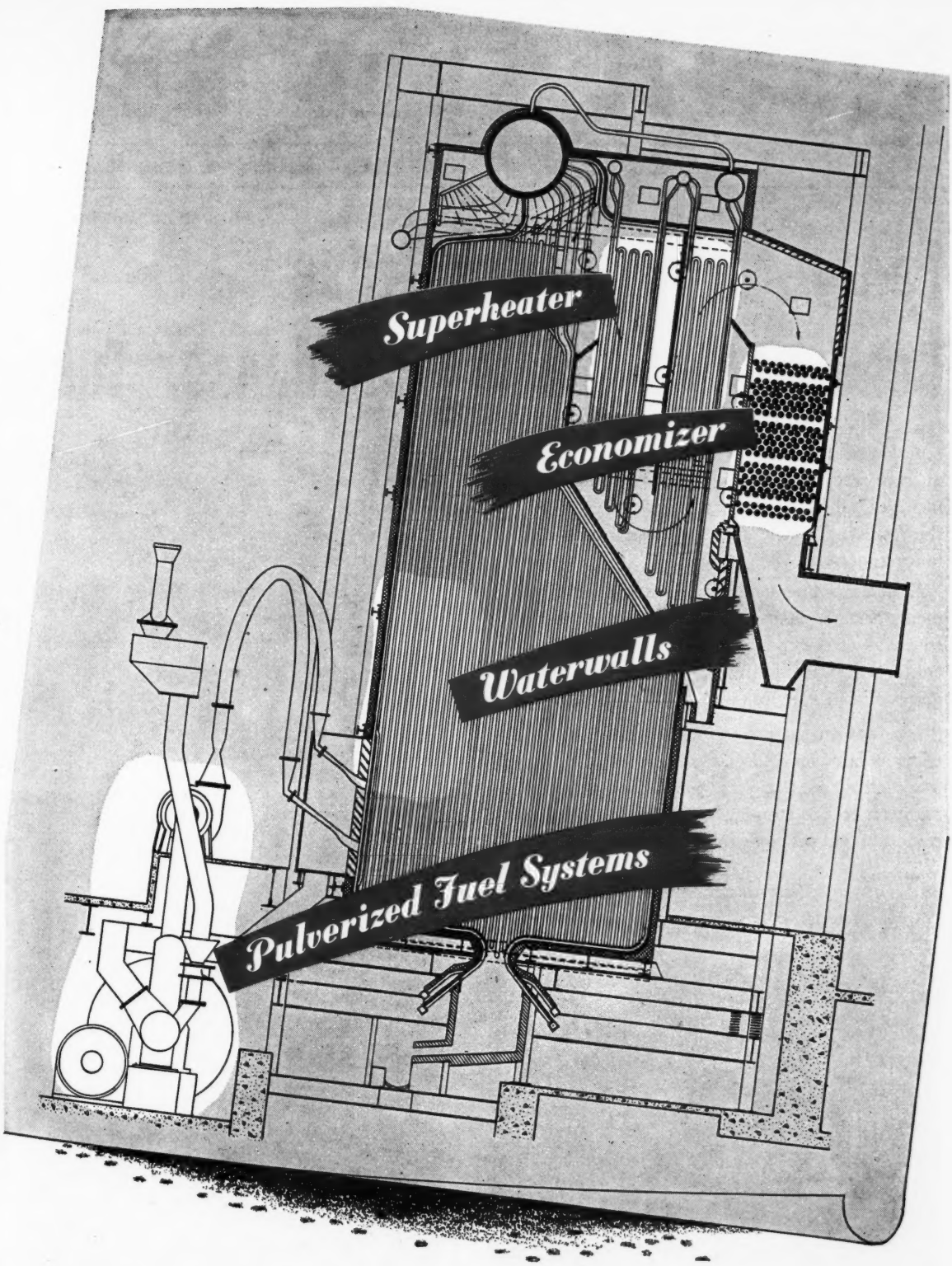
SUPERHEATERS—The first of the three essential components of the modern central station steam generator was introduced in 1904. Superheated steam, once accepted, brought new problems of high-temperature, high-pressure operation. As higher temperatures became common, the special problem of obtaining a constant final temperature over wide load ranges arose. Ultimately a combination type superheater was evolved from the radiant and convection types in use. The combination type insures constant final temperature over wide fluctuations of load.

ECONOMIZERS—Before 1919 the use of economizers for heating feedwater at full boiler pressure was practically unknown. When heat from stack gases was adapted to this purpose an overall gain in efficiency and a reduction in operating costs resulted. With the introduction in 1919 of the unit economizer, the second of the three essentials was established as standard equipment for steam generators.

WATERWALLS—Replacement of furnace brick walls with extensive water-cooled radiant heat-absorbing surfaces—*waterwalls*—was introduced in 1922. Although departing from established practice, the reasons for eliminating brickwork were proved sound by reduced maintenance costs, prolonged furnace life, and higher firing rates in a cooler furnace. This development—the third of the three essentials—paved the way for further progress in designs for operation at still higher temperature and pressure.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N. Y.

FW FOSTER


Superheater
Economizer
Waterwalls
Pulverized Fuel Systems

WHEELER FW

Scovill Tube News

Vol. 4 SCOVILL MANUFACTURING COMPANY, Waterbury 91, Conn. No. 1

Laboratory Services Trace Conditions Affecting Condenser Tubes

An important part of Scovill's service to users of condenser and heat exchanger tubes is the facilities of its laboratory, available to you for the tracking down of conditions causing tube failures.

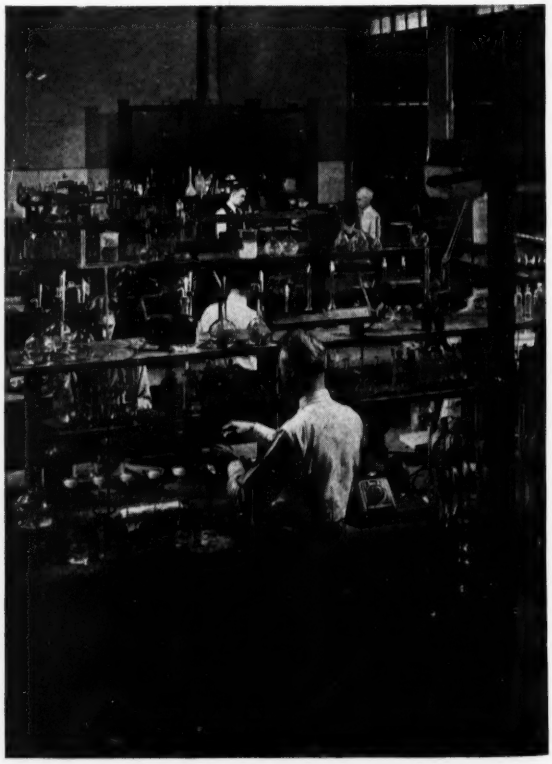
Experienced personnel, operating modern equipment, perform tests and determinations necessary to arrive at the chemical, metallurgical and physical facts concerning the tubes which will eliminate guesswork in studying application problems.

Pictures on these pages offer a tabloid account of what our laboratory is prepared to do for you. They illustrate services which are rendered in addition to the standard specification tests made on individual orders.

Analyses of Elements — Unidentified samples of compounds, corrosion products, deposits or

alloys — sometimes as small as the head of a pin — are analyzed spectrographically to determine the elements present. After classification, a sample might be partially or completely analyzed in this *Spectrographic Department* or turned over to the Chemical Department for complete analysis of the elements as identified. Special spectrographic technique not only can trace concentrations of elements as low as 0.001 per cent, but also assures identification of all determinable elements present in unknown samples.

Performance Predictions — Spectrographic results plus the results of analyses made in our *Chemical Department* can reveal conditions

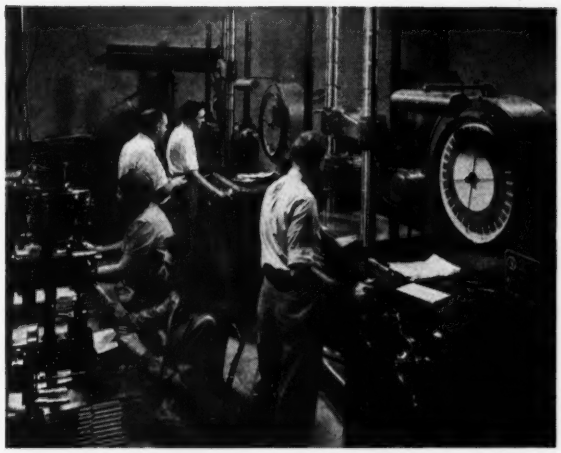


likely to cause early tube failures. The chemists in this department analyze ferrous and non-ferrous alloys, corrosion products, deposits, compounds, circulating waters, condensates, paints, and oils to help establish the facts and details associated with a tube application problem.

Metallurgical Structure — Metallographic examination of a tube at from 50 to 1000 times magnification reveals subsurface defects, possible unsoundness, inclusions, and improper grain structure. Such an examination, made in our ***Metallurgical Department,*** also reveals the nature of the metallurgical structure. This knowledge is important, for a tube material that is chemically

as specified may have metallurgical defects that cause early failure. Microscopic study of tube surfaces also reveals certain tube corrosion characteristics not visible to the unaided eye. Also, the characteristics of cracks as viewed microscopically indicate their probable causes.

Testing for Faults — An important part of the metallurgical data, necessary in establishing the facts to work with in studying a tube problem, is the physical and mechanical testing of the



material as performed in our ***Physical Department***. This information, coupled with metallurgical examination, quickly tests the quality of the tubes in question. Subsurface defects and hairline cracks are readily made visible by methods established in this department.

Three Scovill Services

The laboratories shown here constitute a part of our *Service in Metals* which also includes the production of many tube alloys, and the selection of the proper alloy for specific operating conditions. *Service in Men* provides specialized consultation on individual tube application problems and suggestions regarding installation practices. *Service in Manuals* covers literature prepared from the wide experience of our engineers and laboratories to give you the latest, most authentic information on condenser and heat exchanger tubes; for a free copy of our Condenser Tube Booklet, address Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Conn.

This is Number Seventeen in a series of Scovill advertisements to help you get longer life from condenser and heat exchanger tubes.

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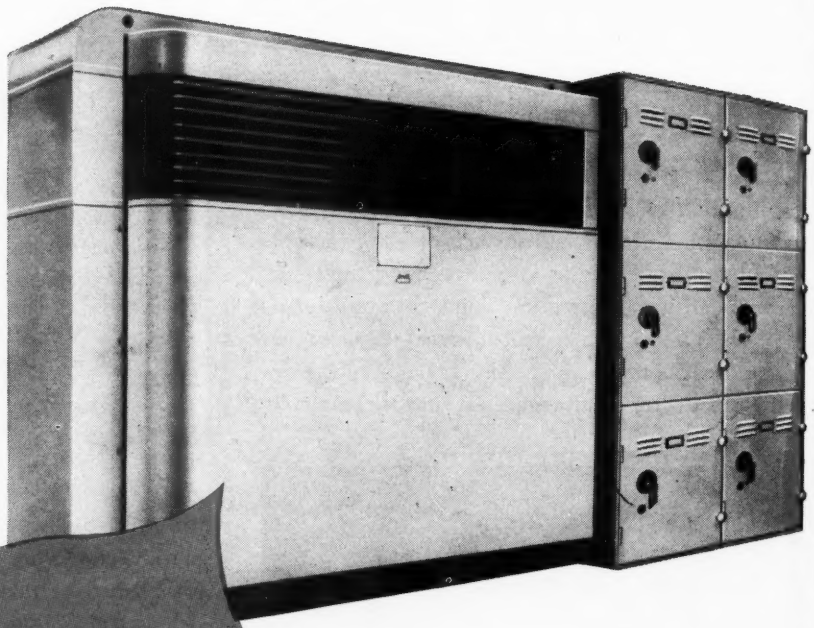
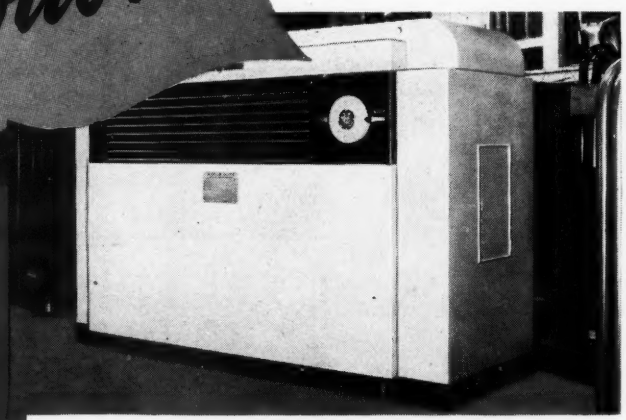
Service in Manuals... Service in Metals... Service in Men

A typical G-E dry-type substation, made up entirely of standard elements and equipped with metal-enclosed, drawout air circuit breakers. Units like this can be added one-by-one until your entire plant is converted to a co-ordinated load-center system.



SOUND DESIGN *inside and out...*

DRY-TYPE



A "bright spot" anywhere in the plant, this G-E dry-type load-center unit substation (150 kva) is completely self-contained, incorporating high-voltage potheads, disconnecting switch, fuses and low-voltage thermal breakers.

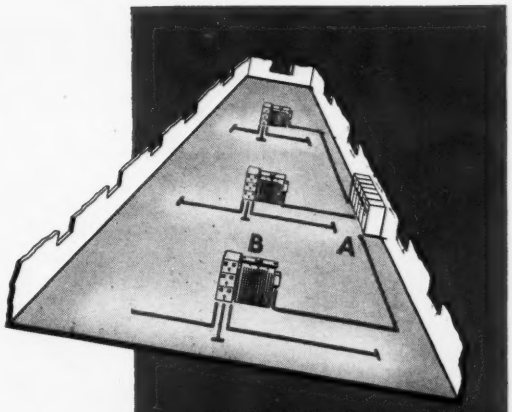
G-E dry-type unit substations are styled to meet 1946 requirements for neatness and clean-cut appearance in your plant equipment-layout. Their design simplicity lends itself to ease of location and facility of installation. Their light weight reduces structural problems.

Users who prefer dry-type equipment will find these unit substations at the top of their class in their ability to handle overloads. For, the transformer sections of G-E dry-type unit substations are designed to meet AIEE Standards No. 1 for Class B insulation, with *130 C maximum hot spot temperature* in a maximum ambient of 40 C. They also meet ASA Standards C-57.1, which limit the observable temperature rise to 80 C.

These unit substations have factory-matched switchgear —that is, the interrupting capacity of the switchgear section is matched, electrically, mechanically, and thermally, with transformer characteristics.

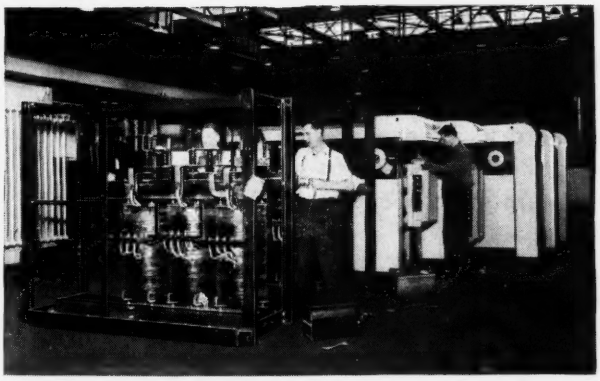
G-E dry-type unit substations are repetitively manufactured. This is a feature adding to their flexibility, for as load requirements change, expansion is met by the addition of similarly matched units, block by block. Thus, a planned efficient load-center power distribution system is always in operation in your plant. G-E dry-type unit substations are available in ratings up to 2000 kva, 15,000 volts.

Ask for bulletins GEA-3592A and GEA-3714B. Call your nearest G-E representative or write to *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



In a modern load-center distribution system, power is distributed from metal-clad switchgear (A) at relatively high voltage (2.4 to 13.2 kv) to load-center unit substations (B) located near the centers of electrical load areas. There it is stepped down to utilization voltage (below 600 volts) and distributed to the load through short secondary feeders.

UNIT SUBSTATIONS



G-E dry-type unit substations have been supplied in quantity since early in the war-construction period, and sizes and types to meet individual load conditions can now be ordered "right out of the catalog."

The terminal compartment casing extends down the entire side of the substation, facilitating cable entrance connections. The unit can be moved into place after conduit and cable have been made up. On vital conversion jobs, this convenience feature will save many precious hours.

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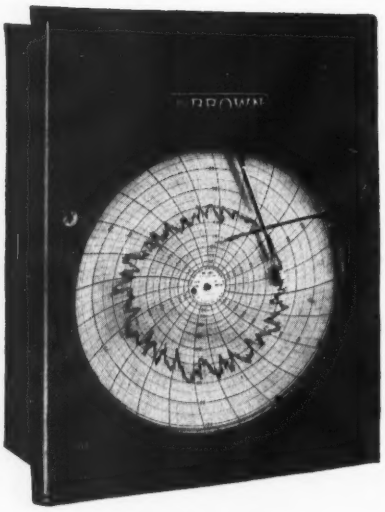

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FUEL is money. Unless you ***know*** how much steam is produced and used at all times, you are burning fuel dollars needlessly . . . wastefully.

With Brown Flow Meters, you can correctly determine the cost of making steam for power, processing or heating and properly allocate costs to departments or units. Brown Flow Meter chart records reveal instantly any deviation above or below the most efficient operating standards of steam generation and distribution.

Thousands of steam engineers are getting this kind of service from Brown Flow Meters. They are easy to install —parts are simple and few. In many plants, the investment for Brown Flow Meters has been repaid many times over. Learn more about them. Write for Catalog No. 2008.

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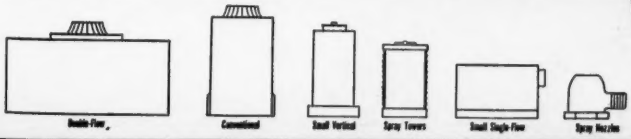

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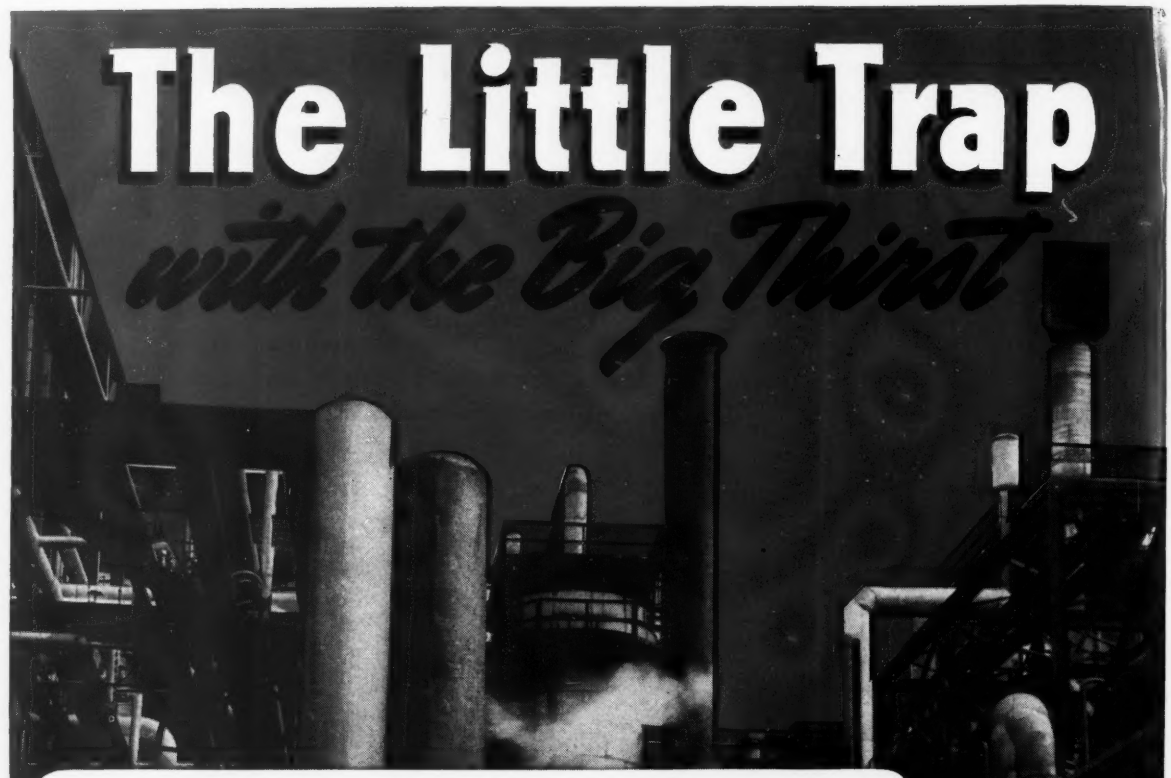
The Little Trap
with the Big Thirst



Yarway Impulse Steam Traps—those little traps with the big thirst—are doing a giant's job for hundreds of plants in many industries throughout the country.

For instance, Yarways are ideally suited to refinery work because they literally *drink* the condensate—discharging continuously on heavy loads, intermittently on light loads. Hence they provide maximum heat in the shortest possible time.

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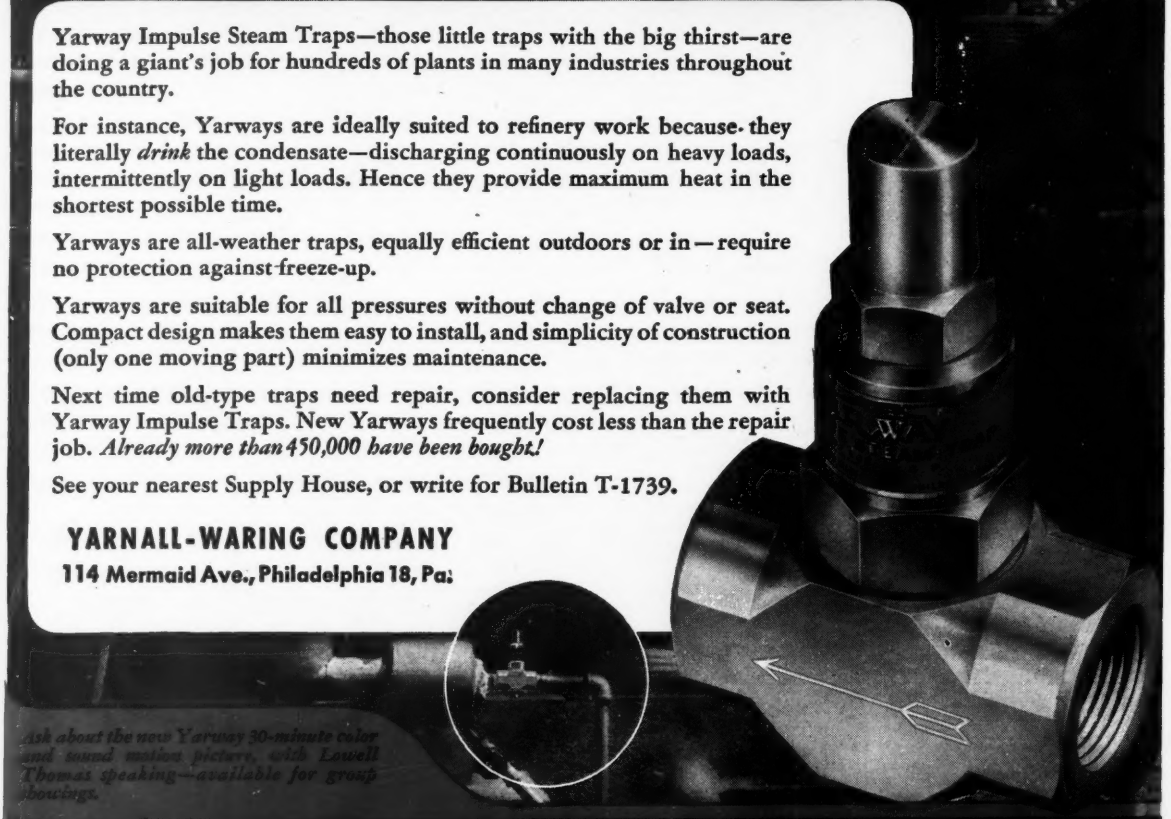


Ask about the new Yarway 30-minute color and sound motion picture, with Lowell Thomas speaking—available for group showings.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

How We Can Make Jobs for Millions

By J. A. KRUG

WHEN I was a boy, some of our industrialists, eager to expand, looked wistfully at China, with its millions of consumers, as a future market for our goods. The only difficulty was, as it is now, that the Chinese could not afford to buy our goods. Today, some of our industrialists, with facilities to serve the whole world, advocate the building up of a huge export trade with Europe as an outlet for the vast productive system we created during the war. Again they are faced with the same difficulty. Can bankrupt Europe afford to buy our goods?

But all is not lost. There is yet another country they may serve—a country as large as Europe, leaving out Russia, unimaginably wealthy in natural resources, highly civilized, and ambitious to get ahead in the world. That country is the Western half of the United States; indeed, more than half, because it comprises 61 per cent of our national area.

These 17 states contain 21 per cent of our population but account for only 11 per cent of our manufacturing.

I want to speak of still another country, which is also a great potential market for top production.

This country is rich in fertile soil, timber, potential hydroelectric power, and strong, intelligent people. But many of these people are poor, although undeveloped wealth lies at their doors. This future market for the "exports" of the industrial East also is part of the United States, consisting of the contiguous states of Arkansas, Mississippi, Alabama, Tennessee, Georgia, South Carolina, North Carolina, Kentucky, West Virginia, and Virginia.

While this vast region contains 20 per cent of our population, and embraces 39 per cent of our farm population, it receives only 11 per cent of our national income and receives only 20 per cent of the farm income. If the income of this region were raised to the per-capita level of the United States as a whole, it has been estimated that the national income would be increased by $10,000,000,000 annually. That is money with which to buy goods in the East and elsewhere.

While 75 per cent of this nation has only 20 per cent of our manufacturing, less than 10 per cent of it has 65 per cent of the manufacturing industry. This tiny area is pretty well concentrated in the Northeastern region of the United States.

This region—it might better be called a district—produces only 4 per cent of our lumber and 26 per cent of our minerals. In natural resources, when compared with the vast underdeveloped regions of the nation, it is comparatively poor. Yet it contains 43 per cent of our total population and receives, as of 1940, 56 per cent of our national income. More than one half of the $17,500,000,000 spent on plants and facilities for war production throughout the nation was spent right in this little area, which, in 1939, paid 75 per cent of the federal income taxes.

We built many war plants in the nonindustrial regions during the war, not necessarily as economic measures always, but for purposes of strategy. Too much of our industry was concentrated in Detroit, Bethlehem, Pittsburgh, and such great centers. If they had been destroyed by bombers, we would have been put out of the war. We had to spread until the danger of bombing had passed. But has the danger passed yet?

But our first consideration is living, not dying. The underprivileged regions of our nation also want to live, and live well. If it is not immediately sound economically to decentralize and more widely distribute industry in this country, to provide jobs and incomes for all, it will be in the long run. Factories will attract population; population will create markets. If it is necessary, the Government should see to it that the war plants now being closed in nonindustrial regions are converted somehow to the purposes of peace and maintained until they can stand on their own feet. It may be necessary. This is not a matter for a nearsighted accountant, but for a long-range government policy of credit and interest.

One does not need to wait for legislation. I think every chamber of commerce in the country should be exploring, planning, suggesting, at this very moment. Every returning serviceman should be thinking, thinking, and planning for his opportunity in this vast country of opportunities. The individual worker, about to lose his job in the West or South, may give his manager a practical suggestion for a new industry that will save the jobs of thousands.

But only recently I heard an industrialist cry out against the decentralization of industry.

He didn't believe that all of us could work together and prosper together. But we can. We did it magnificently in the war. We can do it again. The best example, and it has many ramifications, was our vast wartime power pools. (See POWER PLANT ENGINEERING, October, 1945, page 84).

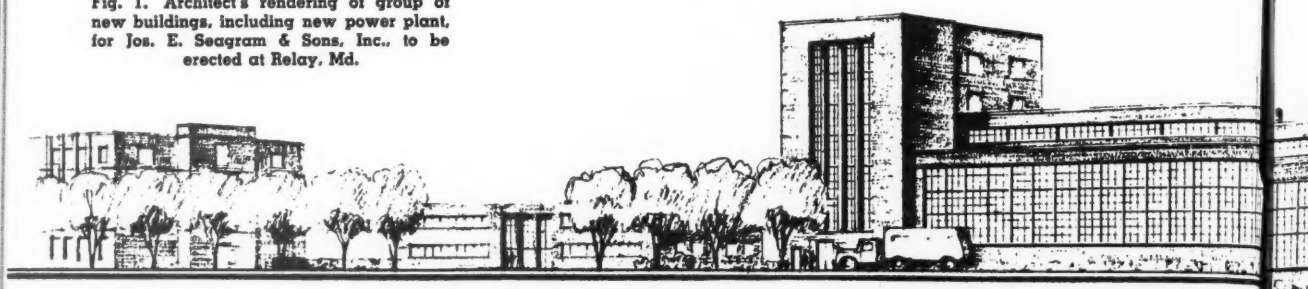
Governmental and private utilities can operate together peaceably, profitably, and for the good of all. In an electric power emergency during the war, all the nation's power systems—private, municipal, county, state, and federal — were assembled in great operating pools. By this means, without new installations, we increased our output of electric energy fivefold.

It is a pattern of power that has made possible the dawning atomic age, and it is destined to harness this power for an epochal advance in civilization. It is also a pattern for national teamwork, which alone will make all of us great and prosperous.

J. A. Krug has been a familiar figure in industry during the war just ended, and particularly so to executives and engineers in the power engineering field. In 1941 he became chief power consultant of the Office of Production Management, later the War Production Board; in January he became director of the Office of War Utilities of the WPB; and in April, 1944, was made director of the entire WPB, serving in that capacity until the WPB was replaced in November, 1945, by the Civilian Production Authority. He was graduated from the University of Wisconsin in 1929 and his subsequent career was entirely in the utility field. He served successively with the Wisconsin Telephone Co., Wisconsin Public Service Commission, Federal Communications Commission and Kentucky Utilities Commission. He was made chief power engineer of TVA in 1938 and manager of power in 1940. The above material is extracted by special permission from an article by Mr. Krug in the January issue of The AMERICAN Magazine. He has just been appointed Secretary of the Interior to succeed Mr. Ickes.

How Seagram Integrates Two New

Fig. 1. Architect's rendering of group of new buildings, including new power plant, for Jos. E. Seagram & Sons, Inc., to be erected at Relay, Md.



New power plants now under construction for distilleries of Jos. E. Seagram & Sons, Inc., at Lawrenceburg, Ind., and the Calvert Distilling Co., Inc., at Relay, Md. . . . Flue gas from steam generating units furnishes heat for spray drying of concentrated stillage, a by-product of distilling process . . . Co-ordination of boiler units with spray driers . . . Each power plant to have initial steam generating unit designed for 425 psi, 600 F . . . Ultimately three boilers in each plant . . . Air compressors and provisions for future steam turbine generating units . . . De-mineralizing system for process water; hot process and Zeo Carb systems for boiler feedwater . . . Details of boilers and auxiliaries

FOLLOWING OUT its announced plans* for post-war improvement and expansion of its facilities, the firm of Jos. E. Seagram & Sons, Inc., is now going ahead with the design and construction of two interesting power plants. The first of these, on which construction work is substantially completed, will serve the company's distillery at Lawrenceburg, Indiana. The second is now under construction and will serve the Calvert Distilling Co., Inc., Relay, Maryland. This plant is located between Baltimore, Md., and Washington, D. C., and is a familiar landmark to travelers approaching Washington from the North on the Pennsylvania and B & O railroads.

*Studies for an Industrial Power Plant; POWER PLANT ENGINEERING, May, 1944.

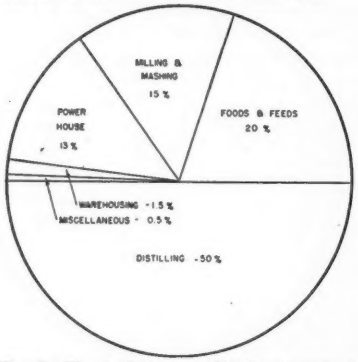


Fig. 2. Chart of steam utilization in a typical distillery

Co-ordination of Power Plants with Processes

The outstanding feature of these two power plants is the way they are being designed for supplying flue gas to spray driers for process drying. Each of the new power plants will ultimately contain three steam generating units, designed for generating steam at 425 psi, 600 F; air compressors; and possibly steam turbine generating units.

The Lawrenceburg boiler units will have a normal capacity of 125,000 lb of steam an hour each, the Relay boiler units a normal capacity of 75,000 lb per hr each. All units will be fired by pulverized coal with fuel oil as the stand-by and low-load operation fuel.

Because the Lawrenceburg power plant is the first of the two to be completed, most of the data in this article will refer to it. Except in a few details of auxiliaries and in the boiler capacity, however, the design of the Relay plant is fundamentally the same as that at Lawrenceburg.

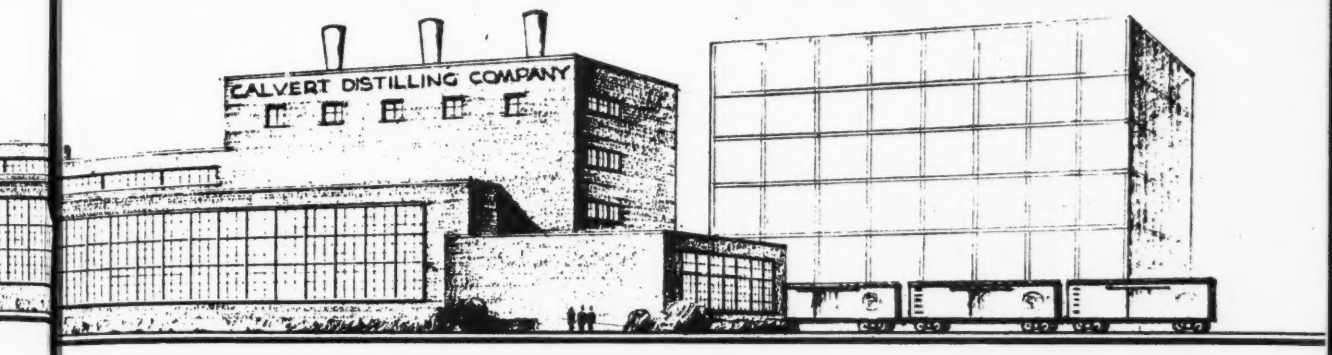
The power plant is the first step in a rather extensive remodeling program to be carried out at each distillery. The existing power plants, in both cases, will remain in operation until the new ones are finished, but each new power plant will be entirely separate from the existing power plant. They will be connected through a reducing valve system, so that the new plant will utilize the present piping systems. An entirely new distribution piping system for steam, process water, electricity and all necessary services will involve both tunnel and overhead construction, details of which are now being designed.

In both new plants, electric power will be purchased at the beginning, but provision is made in the piping design and in the space distribution for future electric generating units as they may be justified.

Principal reasons for co-ordination of the boiler plant design with the spray drying process are that this

Fig. 3. Chart of electric power utilization in a typical distillery

Power Plants with Spray Driers



process reclaims valuable waste products, as explained below, that the process requires heat and that modern spray drying equipment is designed to extract the needed heat from products of combustion. Since the boiler furnaces while in operation will produce these gases in any case, at temperature levels such that they can be utilized by the spray drier, the coordination idea follows logically.

Before detailing the equipment and methods required for carrying it out, let us review briefly the general processes involved and their relation to the design of the power plant.

The designer of these power plants, the consulting engineering firm of Smith, Hinchman & Grylls, has been making preliminary studies for some time of the steam and power requirements of chemical and food processing plants and particularly of distilleries.

How a Distillery Produces Alcohol

In a distillery, ethyl alcohol is obtained by the fermentation of maltose. The sugar does not occur in this form in the grain used by the distiller but is present as starch and is converted to maltose by the addition of malt, which is added during the mashing process.

In this part of the process, meal obtained by grinding grain is mixed with water and cooked by steam to expand the cells and gelatinize the starch. This forms "mash," which is then saccharified by the malt, the resulting liquid being the "wort." With the addition of yeast, this wort ferments to form "beer" but the term "beer" does not have the same significance as in the brewing industry.

Alcohol is driven off the beer by application of steam in a continuous distilling unit, forming "high wine." This high wine is then aged in barrels and, as a result, takes on flavor and color and becomes the whisky of commerce.

Its production is the primary objective of distillery operations but by-products are evolved that have some effect on the economy of the process and much effect on the requirements for steam and power.

Spent Grain a Valuable By-Product

The first by-product is the spent grain, which is marketed as distiller's dried grain to compounders of stock feeds. This is the grain remaining in the beer as suspended soluble matter after the alcohol has been driven off. It is the portion of the grain remaining after the starch has been removed. The de-alcoholized beer, with its spent grain content, as it is drawn from the bottom of the still, is termed "stillage."

One other by-product is CO_2, given off in large volumes in the fermenting process. This may be recovered and liquefied or made into dry ice. Still another by-product is the vegetable oils obtainable from the grain by de-germing before milling or by washing the spent grain with a solvent after drying.

While all steam and power requirements of process operations have their effect on the design of the power plant, the drying of the concentrated stillage is of particular importance in that design.

Drying of Stillage by Flue Gas

The concentrated stillage, usually termed "syrup" and so referred to in Fig. 7, may be dried separately. In modern practice, this may be done in a spray drier, as shown.

The spray drier is a device in which the liquid to be dried is sprayed or atomized through nozzles into a large closed chamber, usually in the shape of an inverted cone. In this chamber the droplets of the atomized liquid meet a current of mixed air and flue gas or flue gas alone. The heat of the gases evaporates moisture from the droplets until a dry residue of spent grain is formed. This accumulates in the bottom of the chamber, from which it can be withdrawn by an exhauster and packaged for commercial distribution. The air or air-gas mixture, whichever is employed, exhausts carrying moisture with it but is not completely saturated, since readsorption of the moisture must be avoided. The outgoing gases may be scrubbed in the liquid collector, the liquid removed being recycled.

Advantage of using flue gas direct in the spray drier is that it is not only economical but also reduces the possibility of dust explosions by reducing the oxygen content of the mixture.

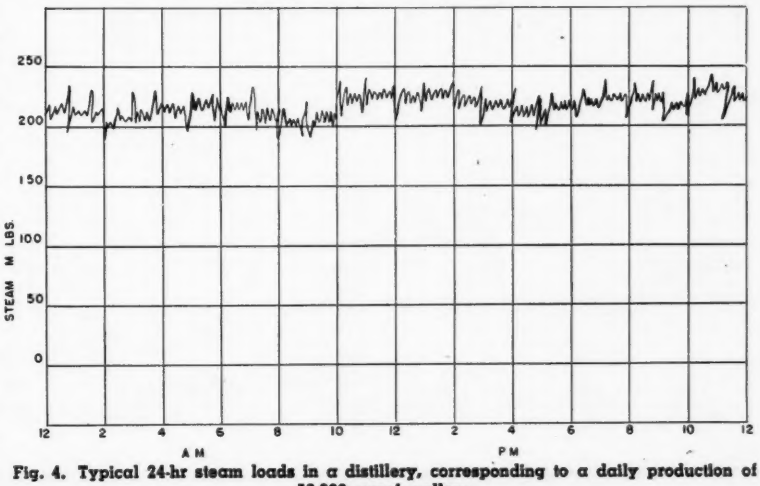
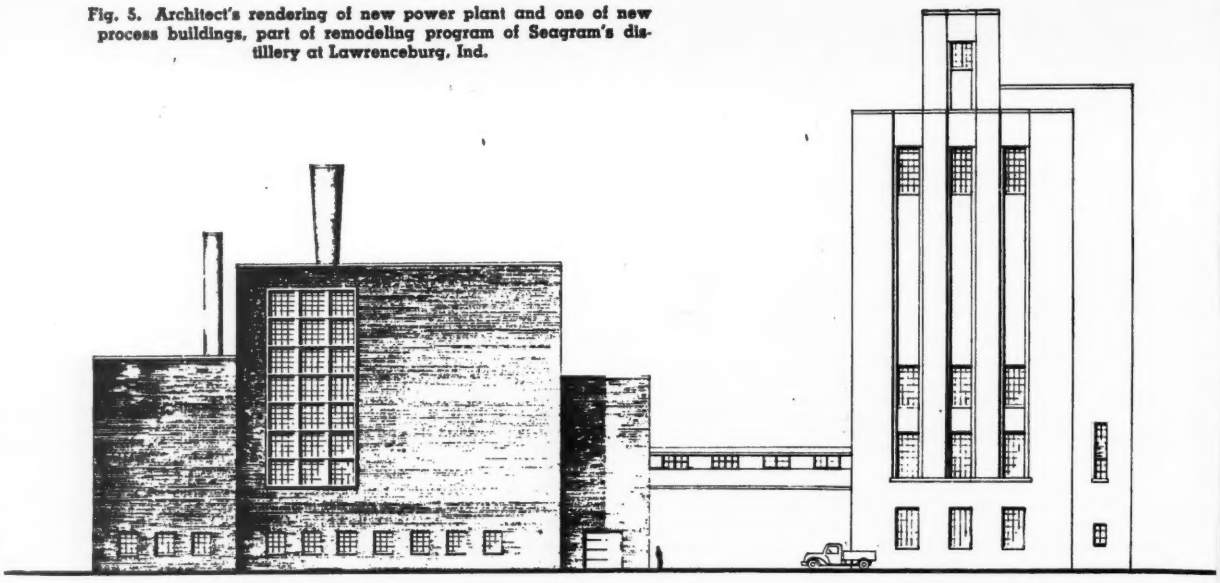


Fig. 4. Typical 24-hr steam loads in a distillery, corresponding to a daily production of 50,000 proof gallons

Fig. 5. Architect's rendering of new power plant and one of new process buildings, part of remodeling program of Seagram's distillery at Lawrenceburg, Ind.



The flue gases are discharged at the vent of the spray drier at temperatures somewhat lower than those at which they would normally discharge from the steam generating unit. Effects of saturation of drier gases, dew point, use of non-corrosive materials in the drier, allowance for water vapor formed as a product of combustion and other similar factors are important in the design of the drier but outside the scope of this article.

General Distillery Steam and Electrical Requirements

Turning now to the steam and electrical requirements of the distillery processes, Fig. 2 and Fig. 3 show respectively the steam and electrical power utilizations of a typical distillery of 10,000 bushels of grain capacity per day. (This is a common method of expressing distillery capacity.) A distillery of this capacity would be considered large. Analyses of the type shown, have been made for the present and future processes at Lawrenceburg and Relay. Fig. 4 shows a typical 24-hr steam load for a distillery.

From studies of steam utilization in these and other distilleries, the consulting engineers find that pressures of process steam required are within such ranges that the greater part of it can be supplied as exhaust or extracted steam from turbine generat-

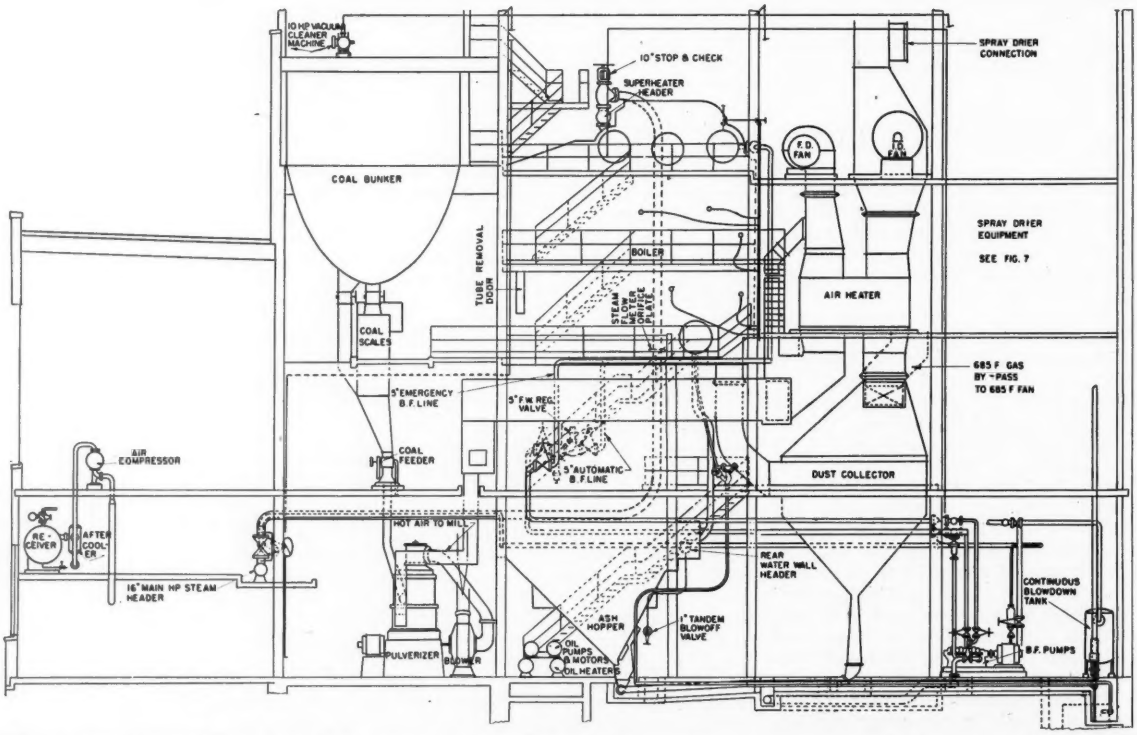


Fig. 6. General cross-section of new boiler room at Lawrenceburg, showing first steam-generating unit and auxiliaries, plant designed for three ultimate units

ing units furnishing electricity to the plant. Usually the process steam requirements exceed considerably the amount of exhaust steam available from the generation of distillery power alone. However, the relation between the percentage of rated capacity at which the distillery is operated and the consumption of steam is in general the same relation as that between rated distillery capacity and electric power.

For a typical distillery, these relations are as follows:

% Rated Capacity at Which Distillery Is Operated	Steam Consumption, Lb. Steam Per Proof Gallon	Electric Power Consumption, Kwhr Per Proof Gallon
30	80.1	2.1
40	70.1	1.9
50	63.0	1.7
60	57.0	1.54
70	50.0	1.4
80	47.5	1.25
90	44.0	1.15

Selection of Steam Pressure and Temperature

Considering all these factors, the power plant designers have found that high-pressure steam generating units are not called for to meet the conditions of the moment. However, in a progressive distillery, it has been observed that development and improvement of processes call for more and more things to be done electrically. Therefore, they have decided to design the steam generating units for pressures and temperature characteristics that will enable more electric power to be generated than the initial heat balance requirements would indicate.

Design of Lawrenceburg Boilers

Following this principle, the power

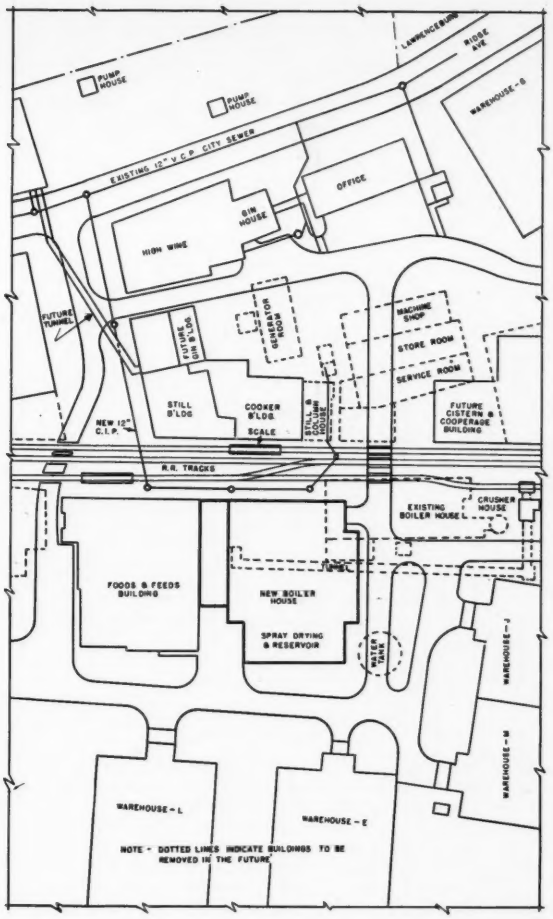


Fig. 8. General plan of Lawrenceburg distillery, showing location of new power plant with respect to existing buildings

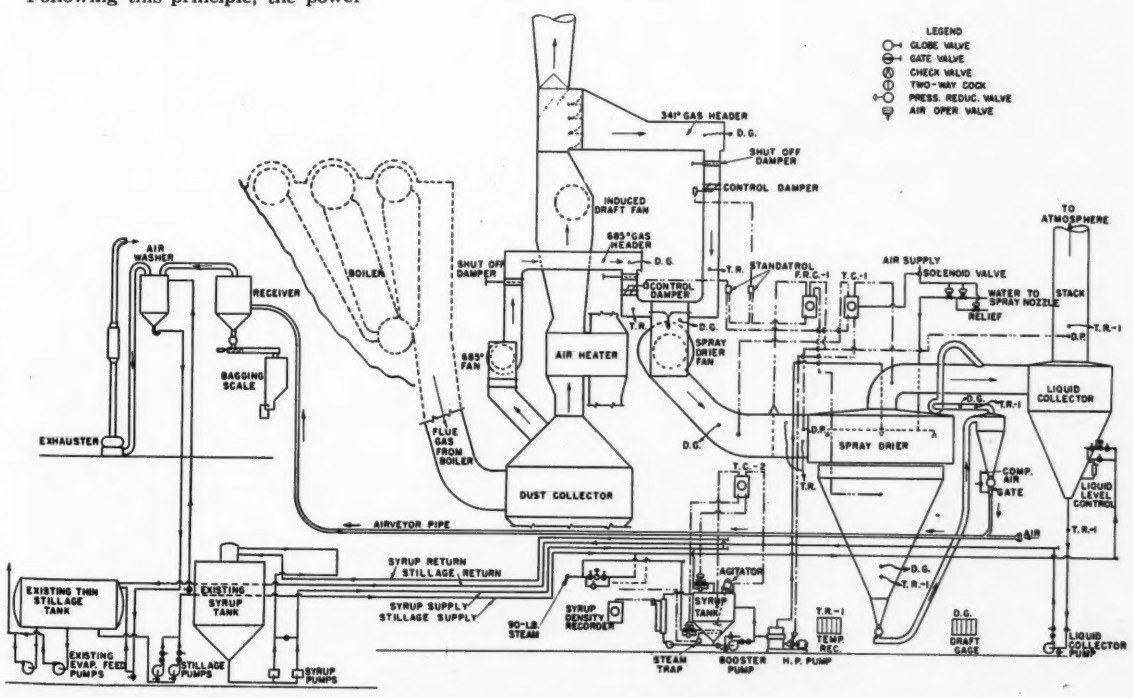


Fig. 7. Diagram showing how flue gas from boiler unit is supplied to spray drier for process work

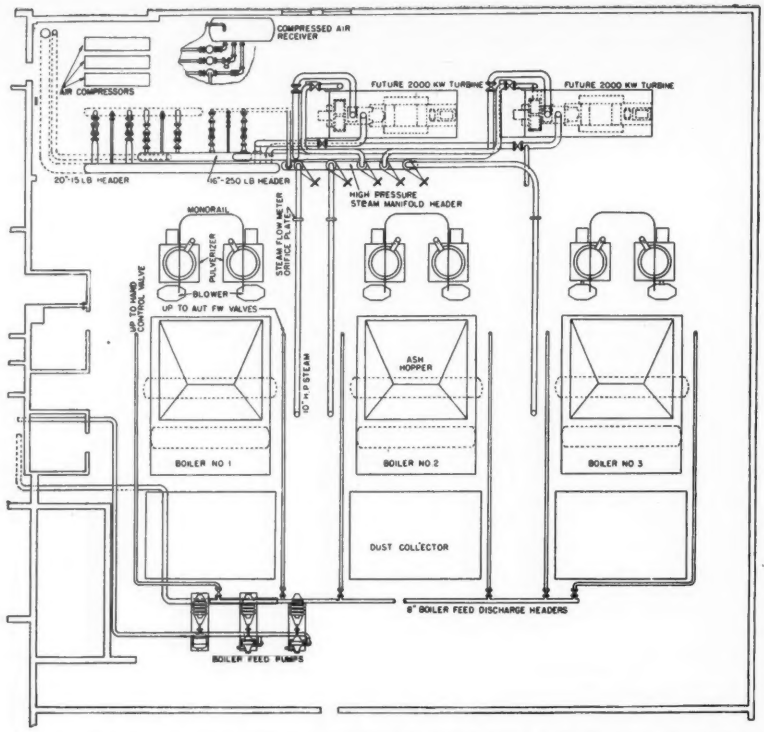


Fig. 9. The ultimate power house at Lawrenceburg will contain three steam generating units, each supplying flue gas to spray drying equipment as in Fig. 7. Provision is made in design and piping for future installation of extraction turbine generator units. For plan of first unit at Relay, see Fig. 15

plant at the Lawrenceburg distillery is designed for three ultimate steam generating units, each with a normal capacity of 125,000 lb of steam an hour, peak capacity of 150,000 lb an hour. These will be arranged in the ultimate plant as shown in Fig. 9, where provision is also made for future installation of steam turbine generators if required.

The first of these steam generating units is a Combustion Engineering Co., 4-drum, vertical bent-tube boiler, designed for ultimate operation at 425 psi, 600 F. Initial operation will be at 400 psi with saturated steam.

This unit is fired by pulverized coal, with supplementary oil firing. It is a standard 4-drum boiler with completely water-cooled furnace of 9160 cu ft designed for a heat release of approximately 16,200 Btu per cu ft per hr.

Coal, the base fuel for this unit, is brought to the plant by rail and delivered to storage or to an overhead steel storage bunker in the power plant. Coal is handled to the bunker by a Webster coal handling system.

From the bunker, coal flows down through Richardson automatic coal scales to the pulverizer feeders on the main operating floor, thence to two Raymond bowl-type pulverizing mills, each having a capacity of 9600 lb per hr. The pulverizer exhausters deliver the pulverized coal to 4 Combustion pulverized coal burners type RO size 21.2-25" in the front furnace wall. These are combination coal and oil burners, each equipped with a Coen mechanical-atomizing oil gun.

These burners are arranged for oil firing to handle light loads but with provisions to handle 60 per cent of full load on oil alone. A standard Engineer Co. self-contained oil pumping and heating system is installed to supply oil from storage to heaters and pump it to burners. This pumping unit has a range from 10 to 35 gpm of Bunker C fuel. The burners are equipped with automatic lighting-off devices.

Combustion air is supplied to each boiler by a Sturtevant forced draft fan, Fig. 6, of 51,000 cfm capacity at 9.10 in. H_2O static pressure. This air is preheated for burner supply and pulverizing mill tempering air, by a 30,300 sq ft Ljungstrom air preheater as in Fig. 6.

Details of Boiler—Drier Flue Gas Connections

At this point in describing the "gas loop" of this boiler, the interconnection of the unit with the spray drier occurs. Part of the flue gas leaving the boiler is now utilized in this drying process, hence the equipment handling this flue gas is arranged differently in some respects from that of a boiler operating independently to generate steam alone.

In this case, three standard elements—air preheater, dust collector and induced draft fan and stack—are employed but in a new arrangement. First of all, it is desired to supply 100,000 lb an hour of flue gas at about 450 F to the spray drier and to have full control over its temperature. Hence, the designers decided to re-

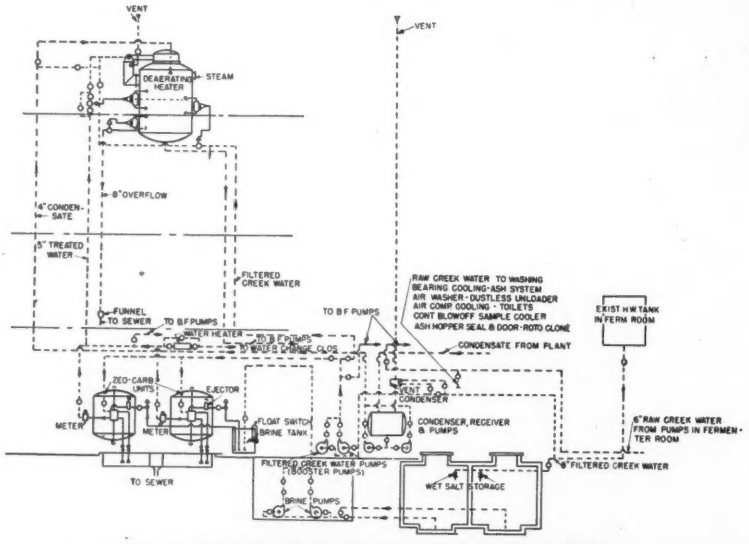


Fig. 10. Diagram of boiler feedwater process piping, Relay

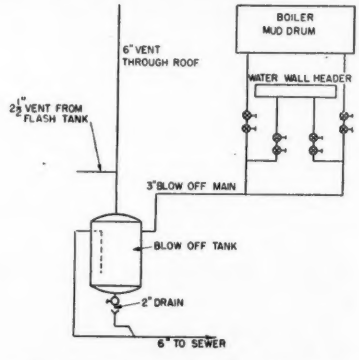


Fig. 11. Diagram of blow-off piping, Lawrenceburg

move part of this gas at relatively high temperature of 685 F ahead of the air preheater, the remainder at low temperature of 341 to 378 F following the air preheater, then conduct both gas streams to a mixing chamber and mix them in the proportions necessary to produce a final gas temperature of 450 F to be supplied to the drier. Moreover, it would be necessary for all the flue gas flowing to the drier to be cleaned. To accomplish this the dust collector was placed ahead of the air preheater.

Figures 6 and 7 show the flue gas circuit. The gas discharging from the boiler outlet passes first through a Thermix dust collector composed of Aerotec tubes. At the discharge of this dust collector, a portion of this flue gas is withdrawn by the special 685-F fan, Fig. 7.

The remainder of the gas passes through the air preheater, which reduces its temperature to between 341 and 378 F. The Thermix induced draft fan draws the gas from the preheater for discharge but just above the fan discharge, before the flue gas flows to the Thermix stack, a second portion of this gas is withdrawn through the connection shown on Figs. 6 and 7., and flows to the mixing chamber ahead of the spray drier fan. The remainder of the flue gas discharges through the stack in the usual manner. Suitable dampers as shown permit the amounts of flue gas from the two sources to be proportioned to give the temperature required for the drier, while drafts, pressures and temperatures are measured at the points shown on the diagram.

The flue gas, at the temperature required, is drawn from the mixing chamber by the spray drier fan, which delivers it to the drier. From the drier, the gas exhausts to a liquid collector, which removes from the gas the vapor it has picked up from the material in the drier. The gas is discharged through the drier stack to atmosphere. The dried material is withdrawn from the powder collector and delivered to the bagging machines as shown in Fig. 7. This spray drying equipment is being installed by the Swenson Division of Whiting Corp.

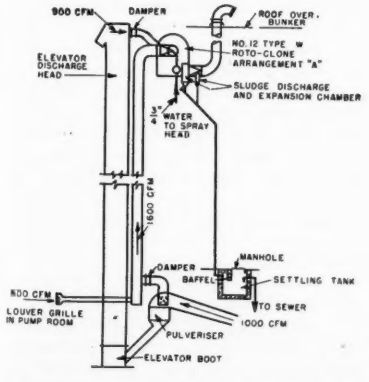


Fig. 12. Diagram of dust elimination system on coal handling system, Relay

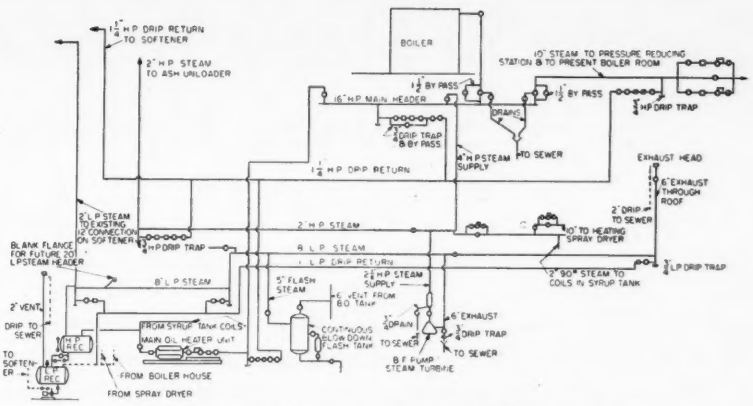


Fig. 13. Diagram of boiler room steam piping, Lawrenceburg

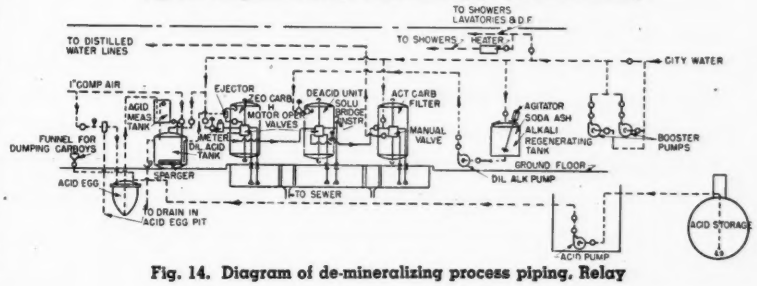


Fig. 14. Diagram of de-mineralizing process piping, Relay

Boiler Auxiliaries

Ash from the boiler furnace and fly-ash collected by the dust collector are withdrawn from the ash hoppers by a standard Nuveyor pneumatic ash disposal system, equipped with air washer, ash storage bin and dustless unloader to discharge the ash to trucks or railroad cars for disposal.

A 10-hp vacuum cleaner is installed in the boiler house on the floor over the coal bunker, as shown in Fig. 6, with pipe connections leading from this machine to various parts of the power house so that all equipment and surfaces can be vacuum-cleaned as desired.

The boiler is equipped with Diamond soot blowers, Edward stop and check and main steam valves, Yarway blow-off valves, National Tube Co. main steam and feed-water piping. Steam may be supplied to the existing low-pressure piping system through Mason-Neilan pressure reducing valve system.

Combustion in this boiler is under control of a Bailey automatic combustion control system. The master steam pressure controller, selector valves, steam-flow-air-flow meter, pressure and draft gages of this control system are installed on a boiler control panel located on the main operating floor near the front of the boiler.

(Continued on page 124)

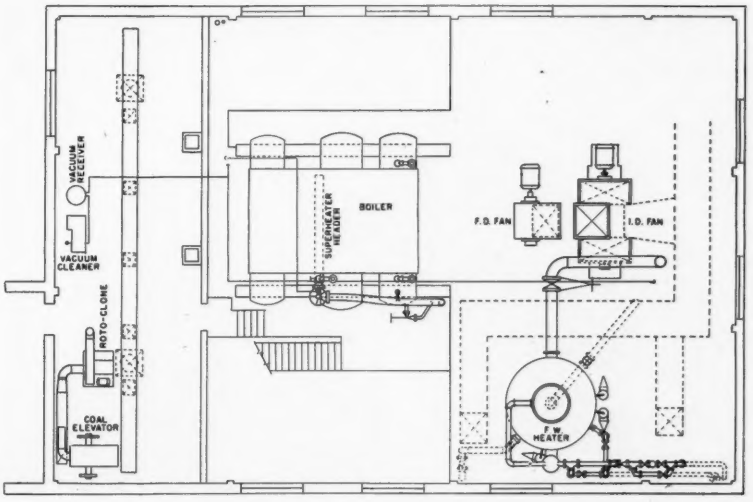


Fig. 15. Plan of first steam generating unit, Relay

Repairs to Steam Turbine Unit Following Hydrogen Explosion

By E. D. St. John

Superintendent of Generation
Kansas Gas & Electric Co.

Removal of scale in condenser by acid process developed accumulation of hydrogen—Events leading up to accident fully described in all pertinent details—Condenser scale contained calcium, alumina and silica—Acid used was 10 per cent solution of inhibited muriatic—Circulation maintained by centrifugal pump—Acid retained in condenser over night—Cutting torch used in making piping changes ignited hydrogen causing explosion — Condenser shell completely wrecked, turbine casing severely damaged—Turbine successfully repaired by metalock method, described in detail—Precautions recommended for acid cleaning

ON JUNE 16, 1945, an explosion occurred at the Wichita Steam Electric Station during the process of cleaning a condenser on a 10,000 kw unit with acid. Fortunately, no one was injured by this explosion but considerable damage was done to the turbine and auxiliary equipment. The following article is presented in order to help prevent such accidents and give information on how the turbine was repaired in order to get the unit back in service as soon as possible.

The unit was taken out of service for general overhaul and inspection on May 28. The reassembly of the unit was almost completed at the time of the explosion since it was scheduled to be returned to service on June 18. During the inspection it was noted that there was considerable scale deposit in the condenser tubes. This scale contained calcium, alumina and silica and was formed at the time of grouting a city dam located approximately ⅛ mile above the plant intake. While this work was in progress a large amount of cement escaped in the water and caused the heavy deposits in the condenser. During the overhaul an attempt was made to remove the scale with a motor driven wire brush, but the deposit was too hard to be removed in this manner and it was decided to clean the condenser with inhibited acid.

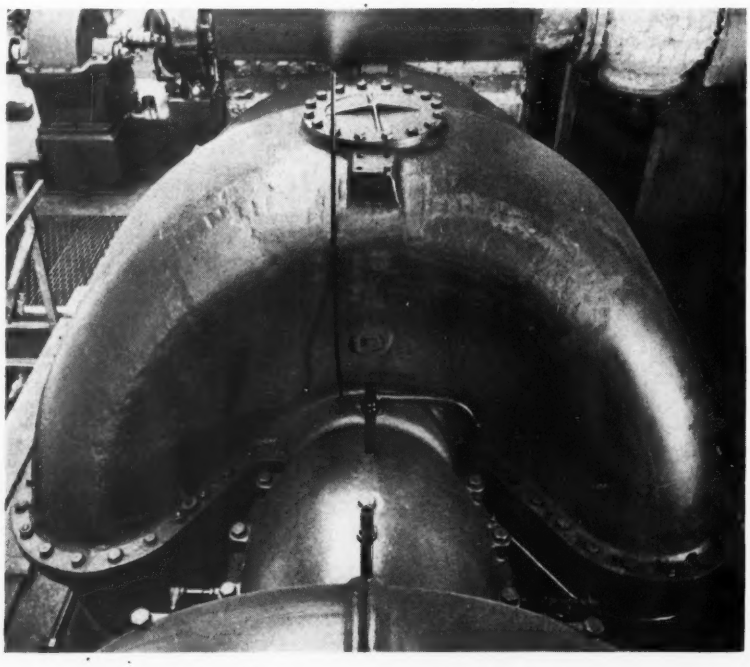


Fig. 1. Turbine case after repairs had been made

The installation of this unit differs from the conventional design as shown in Fig. 2, in that the condenser is located off to one side of the unit in the basement and the steam inlet to the condenser is on the side at an angle of 15 deg from the horizontal.

The condenser is of two pass design with the division in the inlet water box being 15 deg off vertical. The condenser originally contained 25,000 sq ft of cooling surface made up of one inch, 18 BWG tubes. Several years ago, however, in order to improve the performance of the condenser, a large number of tubes were removed in the upper portion and the number of steam lanes increased which reduced the cooling surface to 18,850 sq ft. The condenser shell was of cast-iron construction with a large cast-iron exhaust nozzle extending from the condenser to the turbine with a rubber expansion joint between the turbine exhaust flange and inlet to the exhaust ell.

Cleaning Condenser

The acid for cleaning the condenser was purchased from a chemical company which made an analysis of the scale and recommended the use of a 10 per cent solution of inhibited muriatic acid. It was believed that a 10 per cent solution would be required to remove the estimated amount of scale in the tubes. It was agreed that the chemical company would deliver the acid by truck and pump it into the condenser at the 10 per cent concentration but that their crew would not stay at the plant all during the reaction period. The circulation of the acid and draining of the con-

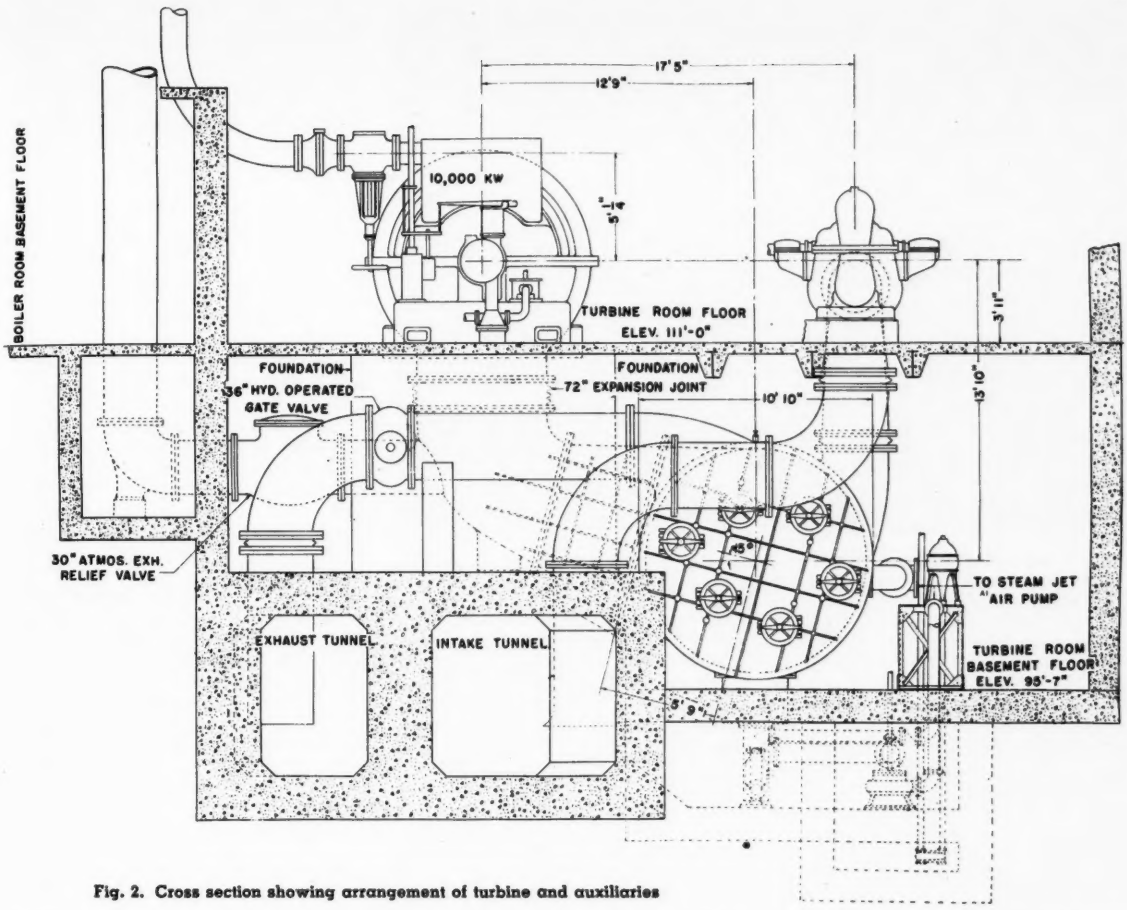


Fig. 2. Cross section showing arrangement of turbine and auxiliaries

denser was to be done by the plant operators.

Vents were installed from the top of each water box and these vents conducted to the outside of the plant where the end was submerged in a tank of water in order to condense the acid vapor. The acid was delivered by truck to the west end of the turbine room and pumped through a temporary line connected to the middle manhole cover on the second pass of the condenser. In order to provide circulation for the acid and overcome the tendency for the tubes to become gas locked, a centrifugal pump was temporarily connected to the drain on the inlet water box with the discharge connected to the second pass of the condenser at the same point as the acid filling line. A schematic diagram of this temporary piping is shown in Fig. 3. A steam coil was also installed in the outlet water box in order to keep the acid temperature approximately 100 F.

Pumping of acid into the condenser was started at 9:20 a. m. June 15, and the pumping was continued until 10:30 a. m., at which time there was considerable discharge of foam from the vent, and no more acid was added until 12:45 p. m. in order to allow the reaction to subside. At 1:00 p. m. the overflow from the vent line indicated the condenser was nearly full and no more acid was added. A total of 5295 gal had been added which checked with the calculated amount required to fill the condenser.

The strength of the acid gradually decreased until at 2:45 p. m. it tested 7.2 per cent. The temporary circulating pump was operated intermittently to circulate the acid through the tubes. The steam coil was used only once for a short period to raise the temperature from 80 to 104 F.

It was planned to remove the acid from the condenser during the night of June 15, but due to the fact that the acid tested approximately 7 per cent at 5:00 p. m., the representatives of the chemical company felt

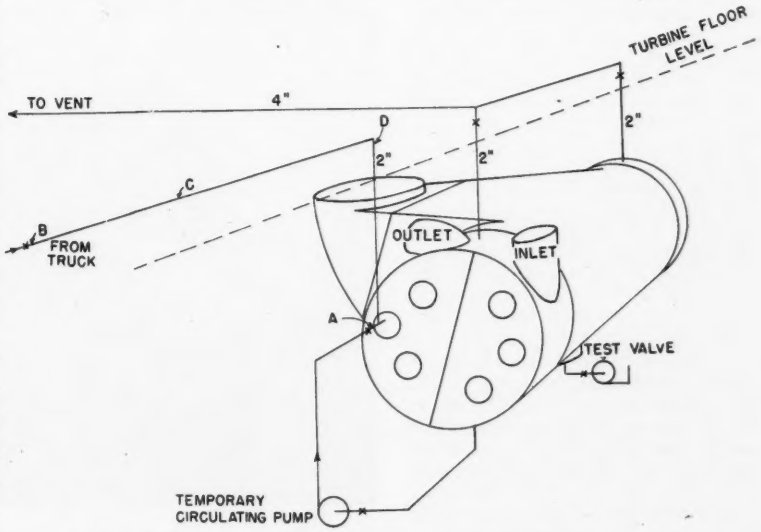


Fig. 3. Sketch of temporary piping installed on condenser for cleaning purposes

Fig. 4. Damaged condenser and exhaust nozzle. View looking toward condenser from under turbine exhaust

that the reaction had not been completed, and recommended it be left in the condenser over night. During the night the plant operator found acid at the test valve on the hot well pump. By morning the level of the acid in the water boxes had dropped below the top manholes and one of the manholes was opened for inspection. The tubes appeared to be clean and the reaction had practically subsided. Since the acid still tested approximately 7 per cent it was decided to transfer the acid to another condenser for cleaning the second unit before discarding it. This second unit could only be taken out of service during the off peak hours, and it was planned to transfer the acid during the night of June 16.

Changes in the temporary piping for this purpose were being made at the time of the explosion. The discharge line of the temporary circulating pump had been disconnected with wrenches from the tee at "A," Fig. 3; leaving the end of the tee open to the atmosphere. Since tubing had been used for the acid filling line, it had been welded in place and workmen started to remove it with a cutting torch. Two cuts were made in this line at "B" and "C," and this portion removed. A third cut was then made at "D"; the operator of the torch had finished the cut and was turning out the torch when the explosion occurred at 2:48 p. m. The vent lines on the water boxes were still in place and open to the atmosphere and all manholes closed.

Damage Caused by Explosion

The explosion appeared to be the most violent in the exhaust nozzle of the condenser which wrecked the nozzle and the condenser shell adjacent to the exhaust nozzle connection. The exhaust nozzle was completely disintegrated as shown by the photograph, Fig. 4, taken from under the turbine exhaust looking toward the condenser. A large portion of the top of the condenser shell was blown out and circumferential cracks extended approximately half way around the shell at the tube support plates.

The turbine was completely assembled at the time of the explosion with the exception of the flange between the throttle valve and control valve case. The force of the explosion in the condenser was transmitted to the turbine case and a large section in the middle of the top half of the exhaust hood was blown out with cracks extending from this opening down to the horizontal joint on both sides. Figure 5 shows the ruptured case and crack on the south side of the turbine. The crack on the north side extended from the lower corner of the opening to the horizontal joint to the rear of the manhole. The bottom half of the turbine case was also cracked on the south side. This crack was not a continuation of the crack in the top half. It started four bolt holes toward the head end and extended downward on an angle of about 60 deg toward the head end of the turbine for a distance of 18 in.

The rubber expansion joint between the turbine and exhaust nozzle was ruptured in several places. The expansion joint prevented much of the shock in the failure of the exhaust nozzle from being transmitted to the turbine exhaust flange, and in all probability much more damage would have been done to the turbine had it not been for this joint.

The atmospheric relief valve disc was forced up through the bonnet, breaking the bonnet and disc. The piping over the top of the condenser was ruptured which allowed steam to come in contact with the acid, and considerable difficulty was encountered in getting the steam shut off due to steam and acid fumes in the basement. A piece of the condenser shell knocked a large hole in the 5-in. concrete floor immediately above the condenser and the concussion caused considerable damage to the skylight in the turbine room roof. The floor, floor plates and piping around the atmospheric relief vent pipe in the boiler room were blown out and damaged. Damage was also done to the generator air ducts due to blowing in the metal partition in the foundation adjacent to the turbine exhaust nozzle. This transmitted pressure into the air ducts and damage was done back to the air washer.

Two other units were in operation at the time of the explosion and a large piece of the casting blown from the turbine exhaust hood struck the throttle valve on a 6000 kw unit, breaking the top yoke of the valve and bending the uprights of the valve

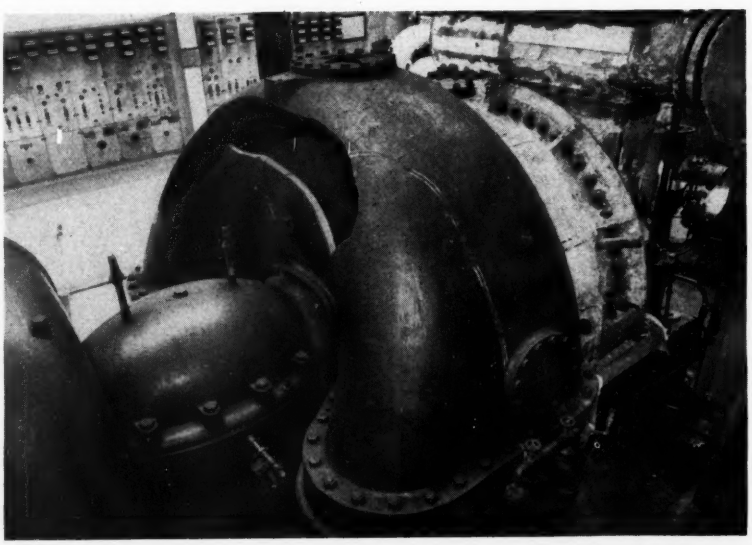


Fig. 5. Showing damage to turbine exhaust case. Crack extending to horizontal joint outlined with chalk

to the west. It was necessary to shut this unit down by closing the header valve. The other 10,000 kw unit remained in operation, carrying full load all during the time of the trouble. Temporary repairs were made to the damaged throttle valve and this unit was returned to service on June 17.

There were three men in the turbine room at the time of the explosion and all escaped being injured. A crew of six men had been working on the turbine but had left the turbine room just previous to the explosion which was a very fortunate coincidence.

Repair of Damage

Even though the unit is relatively small in size its capacity was very badly needed to carry war loads on the system. This system is also a part of the Midwest Power Pool in which the reserves of all the companies in this area were pooled for firming up war loads near Kansas City. Only through close coordination in overhaul schedules was sufficient reserve maintained in the area; therefore, it was necessary to get the unit back in service with the least possible delay.

It was found that all the damage to the condenser was on the steam side. The water boxes, circulating pump and circulating piping were not damaged. Also, the tube sheets, tube support plates and hot well were in good condition, and only a small portion of the tubes were damaged in the top part of the condenser due to falling debris. The three sections of the condenser shell and the exhaust nozzle were beyond repair, and a contract was let for dismantling the old condenser and installing a new steel fabricated shell and exhaust nozzle of the same general design as the old cast iron construction, using the present water boxes, tube sheets, tube supports, hot well and tubes. A top view of the new fabricated condenser shell and exhaust nozzle is shown in Fig. 6.

The condenser contractor promised eight to ten weeks delivery on the erected condenser, and there was considerable discussion of various methods as to how the turbine case could be repaired within this time. The manufacturer advised that a new case was out of the question and there was some doubt as to whether the patterns were still available, since the turbine was built in 1917. Finally the use of Metalock was suggested as a possible temporary measure and representatives of the Midwest Metalock Co. were consulted. They advised they were of the opinion that they could satisfactorily repair the turbine case, and it was decided to go ahead with the metalocking in the nature of an experiment in order to get the unit back in service.

Metalock is a patented process of repairing cracked or broken castings requiring no heat and can be applied to any kind of metal. The term Metalock is used to refer to this patented process. Metalocks are deformed bars of metal having high elasticity and high tensile and compressive strengths with low coefficient of expansion. Each of these locks has a series of indentures and lugs which provide an irregular surface on two opposite sides. These irregular surfaces provide numerous shear stress areas to restore the tensile strength of the casting.

Fig. 6. Top view of new fabricated condenser shell and exhaust nozzle

In the installation of Metalocks the casting is drilled and grooved at right angles to the crack about three-fourths the thickness of the casting. The drill spacing corresponds with the spacing of the lugs on the lock, and the groove between the drilled holes is cut the same width as the lock at the indentures. The size and length of the locks depend upon the strength to be attained and type of metal being repaired. The number of locks placed in a groove depends upon the thickness of the casting. Each lock is driven into the groove with air driven hammers and the last one ground down flush, leaving a smooth surface.

At the point of greatest strain in the casting, larger locks known as Masterlocks are installed. These masterlocks consist of a steel plate inlaid into the casting and locked at the edges by plugs screwed and caulked into tapped holes on the seam. After the locks are installed the fissure is drilled and tapped and plugged with Metalace plugs. These plugs are caulked in place, making the joint air tight.

Since the cracks extending from the rupture down to the horizontal joint on each side of the case were not opened up and showed no signs of shifting of the case at the horizontal joint, it was decided to lock the case on the outside in place before removing any bolts. Three of the large broken pieces were fit into place as shown in Fig. 7, taken while the work was in progress. The parts from the irregular shaped opening were broken into small pieces and a new piece was cast to fit into this opening which is shown lying on top of the case. This view also shows the cavity cut for the large Masterlock at the center of the lower break and two cavities partially cut for smaller Masterlocks on each side of the lifting lug in the top break.

After the locks were installed on the outside of the case it was removed, turned over and locked on the inside. The locks on the inside were spaced so as to stagger those installed on the outside. Five ⅝ in. by 3 in. by 10 in., and one ¾ in. by 4 in. by 12 in. Masterlocks, and one thousand one hundred sixteen (1116) ¼ in. by 9/32 in. seven-lug Metalocks placed three deep in the grooves were used to repair the top case. In addition, more than sixteen hundred (1600) Metalace plugs were required to seal the cracks in this part. Figure 1 shows the case after the repair was completed and the turbine in operation. The surface is smooth and the cracks barely noticeable.

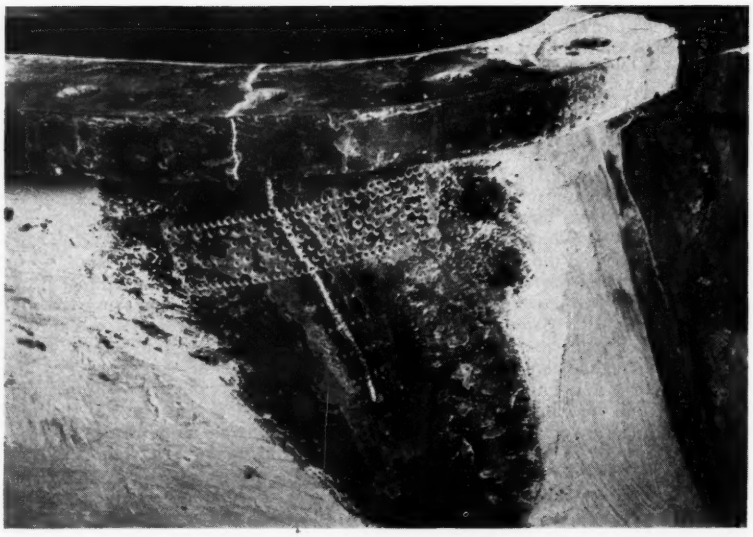
In repairing the crack in the lower case, one ⅝ in. by 3 in. by 10 in. Masterlock and 45 seven-lug Metalocks were used. Figure 8 shows this crack after being partially drilled for locking. This crack was locked only on the outside due to the inaccessibility on the inside. Approximately 60 Metalace plugs were used to seal the fissure.

It required three weeks time to metalock the case which allowed sufficient time to make other necessary repairs, check alinement and reassemble the turbine by the time of the erection of the condenser.

After removing the top case it was found that the rear section had been forced back a sufficient amount to crack the inside seal landing practically all the way around. This was repaired by machining off the inside

Fig. 7. (Left) Top half of turbine case during process of being repaired. Metalocks have been installed except at the right of irregular shaped opening. Casting has been cut out for one Masterlock in lower break and partially cut for two Masterlocks on each side of lifting lug in top break

Fig. 8. (Below) Crack in lower turbine exhaust case after starting of repairs with Metalock



surface of the case and making a new steel landing which was secured to the case with counter sunk cap screws. It was also necessary to machine and shim up the outside landing for alinement with the bottom half. The turbine was completely dismantled and checked for alinement. No shifting of bearing pedestals was found nor no other damage except the bottom diaphragm packing in the last three stages had been severely bumped by the turbine shaft. The turbine shaft was found to be straight upon rotation.

The repairs to turbine and the rebuilding of the condenser was all completed about the same time and the unit was put back in service August 27. No difficulty was encountered in starting the turbine and no air leaks were found in either the turbine or condenser case. The unit was slightly rougher than previous to the explosion which was corrected by adding a small weight to the field. The unit has been in regular service since the refinement of the balance and is operating satisfactorily.

Cause of Explosion

The explosion was apparently caused by the accumulation of hydrogen gas in the steam side of the condenser becoming ignited. Evidently, due to the iron being clean on the steam side, there was sufficient reaction with the inhibited acid to form iron chloride and liberate hydrogen. It is not definitely known how ignition took place since the steam side of the condenser was entirely closed except for the turbine shaft seals and the connection between the throttle and control valve casing which had not been made up.

It may be that after the cut was made at "D" in the line used to fill the condenser with acid there was sufficient gas at this point at the right mixture to maintain combustion and the flame followed back through this 2-in. pipe into the water box and through the hole which had allowed the acid to leak into the steam side of the condenser. There was no evidence of any explosion occurring in the water boxes, and the nature of the leak in the condenser is not known. The cutting torch was not being used in the proximity of the throttle valve connection or turbine seals.

Recommended Precautions

In order to prevent similar occurrences, it is recommended the following precautions be taken when cleaning condensers with acid.

1. Install adequate vents on each water box or other locations where gas may accumulate and conduct these vents to the outside of the building.

2. Fill the steam side of the condenser with water above the level of the acid added to the water side in order to eliminate the possibility of acid leaking into the hot well.

3. Allow no open flames, welding or smoking in vicinity of unit, and signs should be posted to this effect.

4. At no time during the cleaning process should the condenser or any of its connections be opened to the atmosphere.

5. After the acid has been drained from the condenser the vessel should be purged with water before opening for inspection or dismantling of temporary piping.

Similar precautions should also be taken when cleaning any other vessel since hydrogen is generated in all treatments where the acid comes in contact with iron. Although the acid may contain the best known inhibitors, there is still a small amount of hydrogen generated and, under proper conditions, an explosive mixture will be formed. The disastrous results which can occur if the mixture becomes ignited is demonstrated by this explosion; and great care should always be taken to prevent the accumulation of any hydrogen gas in the areas being cleaned as well as to prevent its formation in other areas of the vessel not being treated.

Radiant Heat Thaws Frozen Coal Cars

BULK COAL shipments frozen to a solid mass have presented a major problem to many power plant men in recent years. There have been many approaches to overcoming this unloading headache, varying from applying heat by blow torches or steam to actually chopping the coal out by back-breaking labor. These methods have been time-consuming and costly, both from the manpower standpoint and from the fact that the hopper cars might be damaged by direct contact with the flame from the torches.

Principle of Thawing Pits

A method of overcoming these handicaps by the use of radiant heat from thawing pits is shown in the illustrations. These pits are built between the track rails and are so spaced that when a 2-pocket car, for example, is run over them they will be right under the hoppers. The radiant heat is produced by two burners mounted in small combustion chambers and fired toward each other from the ends of a refractory-lined pit. The installation shown was designed by Hauck Manufacturing Co.

The burners used vary in accordance with the fuel available, whether it be high- or low-pressure gas, or oil, and whether compressed air is available in sufficient volume and pressure. Hauck Venturi high-pressure oil burners may be utilized provided each pit can be supplied with a maximum of 50 cu ft of air per minute at 60 psi. When air is not available in adequate quantities, low-pressure burner units are installed, together with a motor-driven blower and an oil pump. The latter equipment varies in size to serve a number of pits or a battery of burners. When gas burners are used, they are furnished with air-type mixing tees or with gas-air inspirators for low- and high-pressure gas, respectively.

Intense Heat Thaws Quickly

The heat generated by the flaming jets is intense, and it affects every part of the hopper area without direct flame contact. Thawing takes place relatively quickly, depending on atmospheric temperature. The worst freeze-up is reportedly thawed and dumped in not more than half an hour. In normal winter weather a 2-hopper car can discharge fifteen minutes after the burners are ignited. The New York Central Railroad has a coaling station equipped with twelve thawing pits near Rochester, N. Y., where it is not unusual to have temperatures around zero during the winter months. According to the railroad 4301 trains stopped there to take on coal during March, 1944, without being delayed by frozen hoppers.

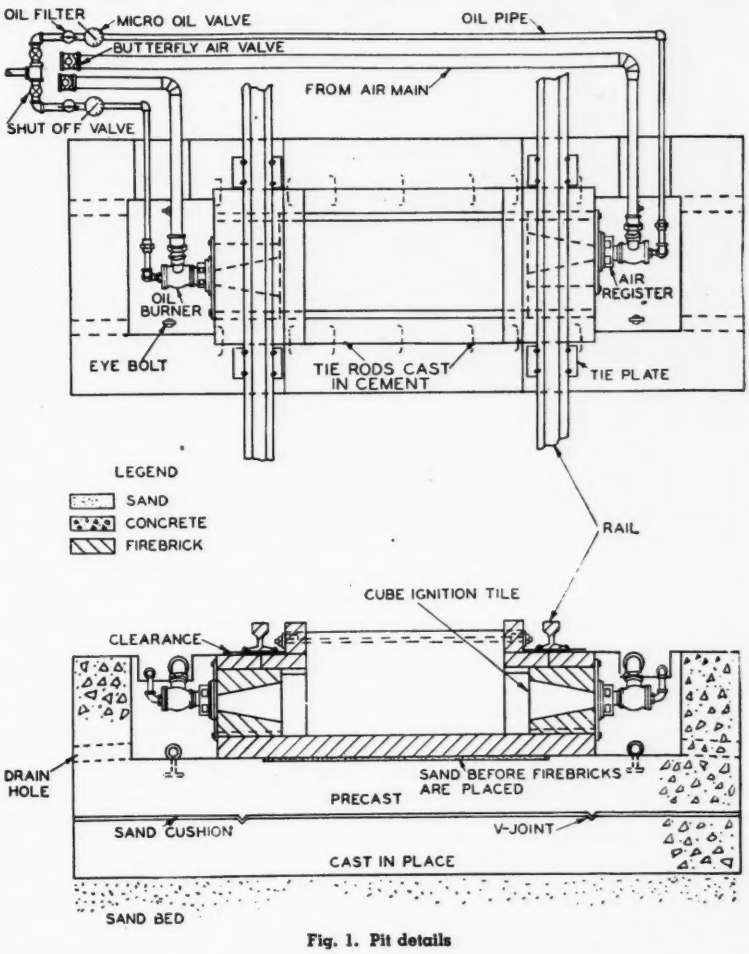


Fig. 1. Pit details

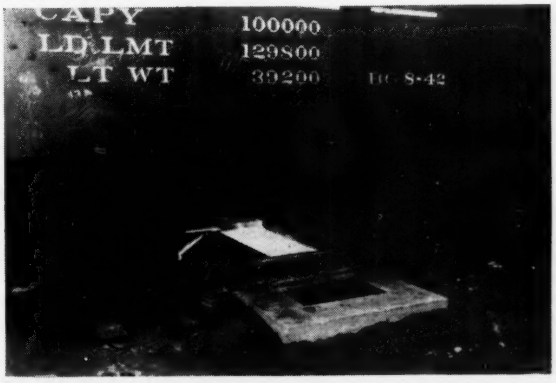


Fig. 2. Thawing pit in operation

Fig. 3. Close-up of thawing pit

Highlights of the A.I.E.E. Convention

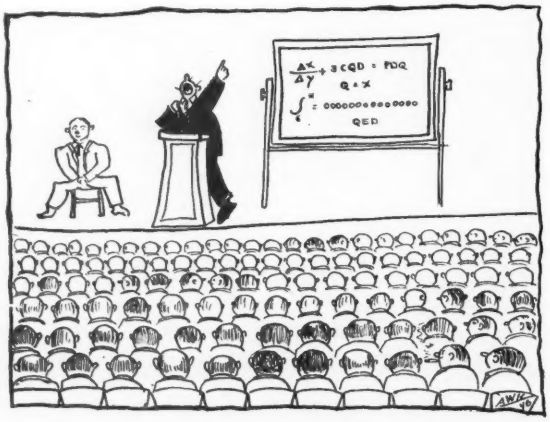
Winter convention of the American Institute of Electrical Engineers held at New York, January 21 to 25 was one of the largest ever held in point of attendance. Nuclear energy and radar were the chief topics of interest but the technical sessions covered the entire field of electrical engineering.

THE WINTER CONVENTION of the American Institute of Electrical Engineers is always one of the most important events of the year for the electrical industry. This year's meeting was no exception, in fact, it was even more interesting because this was the first meeting after the war and the technical sessions disclosed information on many developments which had been on the secret list during the war. Chief among these were the details of the various radar systems and of course, the use of nuclear energy in the atomic bomb. The sessions devoted to the subject of nuclear energy were without question the outstanding ones of the convention; certainly they were the most interesting.

As was expected, the meeting was unusually well attended, the registration reaching the record breaking value of 2580. Whether such a large attendance at a single meeting is good or bad is something that could be the subject of considerable argument, but at least it is indicative of interest in the affairs of the profession on the part of many. The Winter Technical Meeting of the Institute of Radio Engineers which was also held in New York during the latter part of the same week as the A.I.E.E. meeting was similarly well attended, but here the attendance rose to such a point that it greatly overtaxed the facilities of the Hotel Astor where it was held and thus resulted in much discomfort, general confusion and annoyance to those attending. Big meetings are not necessarily better meetings. The A.I.E.E. meeting was held in the Engineering Societies Building at 33 West 39th Street had better facilities and though the meeting rooms were often taxed beyond the seating capacity, on the whole there was no confusion. Certain of the features of the I.R.E. and the A.I.E.E. were held jointly.

The scope of the A.I.E.E. convention was broad as always. It covered practically the whole field of electrical engineering from the generation of electricity to its use in air transportation. Electronics, was not given as much attention as a subject this year as in some previous years but it entered into practically every other subject discussed at the meetings. Electronics, in other words, is reaching the point where it no longer is considered as a separate subject but is being accepted as an integral part of electrical engineering whether it be in the communication field or in the industrial field. The electron tube is becoming as much a part of the ordinary electrical circuit as a resistor or switch.

Radar was given considerable attention at two sessions on Tuesday, January 22, the second day of the meeting but, of course, even in two sessions the subject could only be touched upon. The papers presented at these sessions were devoted mostly to descriptions of radar systems for marine and air navigation and to a discussion of some of the general considerations underlying radar phenomena. There were however some rather interesting off-the-record conferences concerning the practical application of radar equipment in industrial work.



Bigger but not necessarily better conventions

Attention was directed in these discussions to the characteristics of the hydrogen thyratron as a substitute for rotary and enclosed spark gaps for momentarily high-output pulsing. The principle of pulsing brings about tubes with astonishingly high power outputs yet having small physical dimensions. Tubes having peak outputs of 2600 kw were cited as being suitable for sealing glass, plastic preheating, welding, etc. Aside from any bearing on its practical peacetime application, radar was of general interest to many of the engineers at the convention because of its general appeal. As J. J. Pilliod who presided at the first radar session pointed out, radar was the deep military secret of the war—*only some ten million people knew about it.* It started way back in 1922 but nothing much was done about it until about the battle of London. By that time the British had developed it to a high degree. Whether it saved London is probably open to question but it contributed a great deal to winning the war. D. A. Quarles of Bell Telephone Laboratories who discussed the general considerations of radar systems pointed out that in radar the antenna is all important. In their own work at Bell Lab. he said they always began with the antenna and always ended up with it. The two vital elements of radar systems outside of the antenna are the cavity magnetron and the TR switch. The first enables us to generate high power waves of extremely high frequencies and the second makes it possible to switch the antenna from the transmitter to the receiver at a rate of many thousands of times per second. Another interesting fact about radar systems is that, especially in the microwave types of radar systems, the frequencies are so high that the transit time of an electron traveling at thousands of miles per second, across the elements of a vacuum tube is too long to permit such tubes to be used as detectors of the radar signals. This is the reason for using the "cat whisker" type of detector. This detector consists of a fine wire in contact with a crystal, the combination acting as a rectifier. Since the wire is in actual contact with the crystal, the transit time of the electrons is reduced to a minimum.

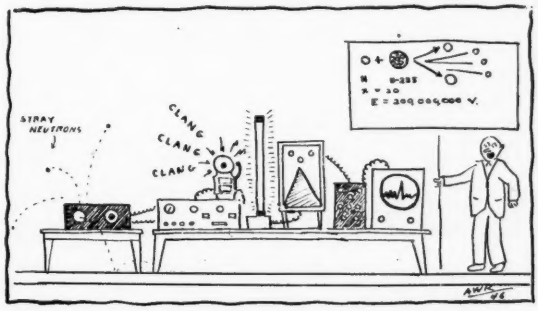
Nuclear Energy

The high point of the convention unquestionably was the demonstration

and lecture on the development of atomic energy by Dr. John R. Dunning at the General Session on Wednesday morning. It was at this session that the Edison Medal was presented to Philip Sporn.

Dr. Dunning held the audience fascinated for the better part of two hours, largely by his clear, interesting and well delivered exposition of the principles of nuclear energy but also with the interesting demonstration of nuclear fission he had arranged. This demonstration was as simple as it was convincing. The equipment consisted of a Geiger-Müller counter the inside of which was coated with a thin layer of uranium, connected through electronic amplifiers to various devices which would indicate the breakdown of the counter by the fission of a uranium nucleus. One of these devices was an electric gong. Another was a fluorescent lamp and finally there was a 20-in. cathode ray oscilloscope. The system was excited by a small amount, one milligram, of radium arranged to produce neutrons from beryllium. When the radium beryllium neutron source was placed in a container near the Geiger counter, fission began to take place in some of the uranium atoms and the indicating devices responded accordingly. The rate of such fissions, however, was slow because the neutrons producing the fission were moving too fast. As is now well-known, slow neutrons are necessary for nuclear fission. To slow up the neutrons, Professor Dunning then poured water around the tube containing the source of neutrons and almost at once the process speeded

A. W. Hill, Westinghouse; W. R. Brownlee, Commonwealth and Southern; H. B. Wolf, Duke Power Co., and M. H. Hobbs, Westinghouse



Professor Dunning gave a demonstration

up noticeably. Slow neutrons said Dr. Dunning are more effective than fast neutrons in entering the nucleus of a uranium atom because it takes time for the natural forces of attraction to act. As he put it, the process can be compared to that of a pretty girl walking down the street with a boy going at a fast pace in the opposite direction. He rushes by her so fast that he doesn't notice her and so nothing happens. On the other hand, another boy, one not in a hurry comes along and as he approaches the girl, he looks her over and, quite often something happens as a result, only usually the result is not fission. In other words, the slowness of the process has given the natural forces of attraction opportunity to act; boy captures girl or vice versa. In the experiment, the water of course, acted as a neutron velocity moderator. As Dr. Dunning put it, to start a neutron fire you pour on the water.

In his lecture, Dr. Dunning traced the history of nuclear physics from the work of the early investigators to the work done under the Manhattan project. He discussed the energy relations involved in the various nuclear reactions and showed how, gradually the scientists had improved their technique in bombarding nuclei with various types of particles and how, in 1939 as a result of the experiments of Hahn and Strassman in Germany knowledge of nuclear fission became a fact.

Thus far, said Dr. Dunning, the electrical engineers have been concerned only with the external electrons of the atom. "You have been pumping them around from atom to atom around copper wires and selling them." Now, he pointed out, the engineers will have to take into consideration, the nucleus of the atom for it is in the nucleus that the power engineer of the future must look for his source of power. Dr. Dunning declared that the harnessing of atomic energy will become possible when metals capable of withstanding the necessary high temperatures are developed.

Dr. Dunning in recounting some of the details of the work done at Oak Ridge presented some interesting facts regarding the work on the gaseous diffusion separation process. The gas cells comprising the diffusion chambers had to be absolutely gas tight and that meant that they had to be welded. No ordinary test for these welds would do, they had to be tested by the mass spectrograph method. When it is considered that there were some 30,000 miles of welding and that these welds had to be tested by a method that theretofore had been only a refined laboratory procedure, some idea of the job that was done, is had. Valves on the system also had to be tested by the mass spectrograph method. Crane Co. made over 85,000 valves all of which were so tested.

Philip Sporn in accepting the Edison Medal also touched upon the possibilities of atomic power. Some day, he said, the cheapened cost of U-235 will enable it to displace coal as a fuel in large power plants but so far the boiler for the job has not even been designed.

Sporn on Electrical Transmission

Mr. Sporn's address was particularly good. He referred briefly to the importance of the year 1945, the year for which he received the medal; that it saw the end of the war; the launching of the United Nations Organization; and the use of nuclear energy in a bomb. He implied that though nuclear power was a possibility, for some time to come, at least, we would

The natural attractive forces have to have time to act

have to depend upon our established source of power and upon the electrical industry. He traced briefly the course of the electrical industry and paid tribute to Thomas Edison for his foresight and genius in conceiving the electrical system as a whole. He spoke of Edison's refusal to accept the idea, then prevalent, that the internal resistance of the generator should equal the external resistance of the load. "No," he said, "do you think I want to waste 50 per cent of the power? I am going to make the internal resistance as low as possible." And he did. From the beginning, Edison was practical; he was convinced of the necessity of economy. As a consequence, he developed the system as a whole, complete with switches, circuit breakers, fuses meters, and other protective measures.

Referring to the transmission of electric power, the field in which he has been most active, Mr. Sporn said that transmission of electric power had freed man from the fetish of fixed locations and that this had improved the economic status of large masses of our people. In the development of nuclear energy he saw a further extension of electric transmission. It is probable, he said, that the development of atomic power will require plants far larger than anything that we have built and this will further the transmission of electric power.

Dr. Dunning's lecture was given on Wednesday morning. That evening in a joint meeting with the Institute of Radio Engineers, the Hoover Medal was presented to W. H. Harrison and at this meeting Major General Leslie R. Groves delivered an extremely interesting address on the atomic bomb project. General Groves did not confine himself to the electrical engineering aspects of the project but instead gave a general account of the Manhattan project as a whole. Since he was the head of the project his personal reactions were of particular interest. The general's talk was followed by a showing of the official motion pictures of the explosions of the bombs at Hiroshima, Nagasaki and also New Mexico.

A final session dealing with nuclear energy was held on Friday morning. At this session Dr. K. K. Darrow gave one of his delightfully amusing and at the same time clear expositions of the realm of nuclear physics. Nuclear physics, said Dr. Darrow is very easy to explain if you know where to stop, and stop there. In accordance with this assertion, when he came to the point where he knew he should stop, he stopped there and so everybody was satisfied.

Other speakers at this symposium on nuclear energy, were Dr. C. G. Suits, Director of Research, General Electric Co. and Philip W. Swain, Editor of Power. Both Mr. Swain and Dr. Suits dealt with the economics of the peacetime use of nuclear energy and both of them were inclined to think that there was a great deal of development to be done before atomic power plants would become feasible from an economic standpoint.

Slepian Cautions Against Too Much Conservatism

In discussing these talks Dr. Slepian of Westinghouse though he agreed generally with Dr. Suits and Mr. Swain, cautioned against taking too narrow a view of the situation. He pointed out that as far as nuclear energy is concerned we are now about at the point where the x-ray tube was 50 years ago. At that time Roentgen had invented the x-ray tube and we knew something of what it could do; see through solid objects, disclose the bone structure of living animals. We could predict something regarding its use in the diagnosis and treatment of disease and we might even have predicted the use of the tube to examine the internal structure of steel castings. We could not, however, foresee that the x-ray tube would eventually lead to a revolution of the telephone industry by giving us the telephone repeater, nor could we have predicted that it would give us the whole radio industry — broadcasting, television, radar, etc. This, said Dr. Slepian is only the first application of nuclear energy and so far as we are only concerned with the heat developed in the fission process. A source of energy which gives us only heat cannot make a great difference in our economy. But who can tell in which direction nuclear research and development is going to lead us? Many people have tried to bring about the direct conversion of the energy in fuel to electricity, without success however. Suppose, however, that we attain this result with nuclear energy; this would upset all our economics and we would have to revise all our ideas regarding the cost, generation, distribution and use of power. The first problem with regard to nuclear energy, however, said Dr. Slepian, is not power but to escape destruction.

Industrial Voltage Requirements

It must not be assumed that because of the emphasis given here to the subjects of nuclear energy and radar that the entire meeting was devoted to these subjects. The bulk of the proceedings of the convention dealt with the more prosaic but practical aspects of electrical engineering. The conference on industrial voltage requirements for example was of great interest to industrial power engineers as well as to utility engineers. At this conference informal papers were presented, including the interim report by the A. I. E. E. Committee on industrial power applications. Analysis of the report and the discussion which followed indicated a widespread desire on the part of operating engineers for closer voltage regulation from the supplier. Only few were willing to continue to accept variations in excess of 5 per cent. A large percentage is anxious to limit the variation to 2½ per cent or less. Surveys show that in many metropolitan areas that the voltage at the delivery point is maintained within a spread of from 1 to 3 per cent. In less developed areas, a variation of 5 per cent or more is common.

It was pointed out in the discussion that the power companies cannot supply uniform voltage to every customer. The man at the end of a long line cannot get the same regulation that the customer close in can. As Mr. Armstrong of the Public Service Co. of Northern Illinois pointed out, it seems that the utilities and the industries are caught on the horns of a dilemma as far as the question of voltage is concerned. The real problem he said is that we have been trying to ride two horses at the same time. What is necessary is to get the designers of lamps and industrial electrical equipment together. He said he has seen lamp ratings go from 110 to 120 but there has been no such shift in the voltage ratings of other equipment.

Beware of the Lawyer

A point of particular interest regarding the question of voltage that was brought up in the discussion was that regardless of how much engineers might argue among themselves about the question of voltage, care should be taken to see that legislation is not passed that will demand requirements that cannot always be met. Engineers can understand why in a particular case certain voltage standards could not be met but it would be difficult to convince a lawyer.

Another of the conferences of considerable interest to electric power engineers was the one on excitation systems on Friday afternoon. Several informal papers were presented at this conference dealing with different types of excitation systems. These considered motor-driven exciters, shaft-driven exciters and electronic exciters. There was considerable divergence of opinion regarding these various systems and also whether excitation systems should include the

voltage regulation function or whether this should be a separate function.

R. B. Bodine, S. B. Crary and A. W. Rankin of General Electric in their paper "Motor-driven Exciters for Turbine Alternators" advocated the use of the motor-driven exciter. Clarence Lynn of Westinghouse, however, asserted that the only reason for resorting to the use of a motor-driven exciter would be to guard against a failure of a shaft exciter requiring the shutting down of the turbogenerator. Recent improvement in 3600 rpm exciters he said, have given them the reliability approximating that of the main unit. J. F. Miller of G. E., on the other hand felt that commutators at high speed did not perform well under vibration conditions unless aided by new brushes and brush holders now available.

In the end, however, Mr. McClure of General Electric said that the customer is free to pick whatever excitation system he prefers since the various rotating exciter systems are practically the same in cost, less, incidently than electronic excitation systems.

Electronic excitation systems, however, according to F. M. Porter of American Gas & Electric Service Corp., have performed well. All the electronic exciters and regulators installed on the A. G. & E. system have given excellent service and his associates he said are convinced that these applications are no longer to be regarded as in the experimental stage. The initially high tube mortality has been corrected by the substitution of sealed ignitrons for the earlier pumped vacuum units.

Of particular interest was the description of the design of the electronic exciter for the 65,000 kw turbogenerator at the Springdale plant of the West Penn Power Co., by W. R. Farley and C. R. Marcum both of Westinghouse. This is an ignitron type unit scheduled to go into operation about the time of this writing, mid-February.

As a session on Industrial Power Applications, D. L. Beeman of General Electric Co. presented a paper on Combined Light and Power Systems for Industrial plants. In this he pointed to the economy inherent in such combined systems. He recommended 480/277 volt substation supply for 260 volt two lamp lighting; also separate transformers for resistance welding loads.

First Industrial Application of the Betetron

At this session also, J. P. Girard and G. D. Adams described the application at Allis Chalmers of the Betetron to the x-raying of castings and other machine parts. The Betetron, invented by Dr. Kerst at the University of Illinois, accelerates electrons by magnetic induction making possible the production of x-rays of much greater energy than can be produced by ordinary x-ray tubes. For radiographic use an energy of 20 million electron volts is developed with the unit at Allis Chalmers and with it flaws are detectable in steel 20-in. thick. This is the first practical application of the Betetron. A 100 million volt unit is now in operation at the General Electric Co. in research on nuclear physics.

Tomlinson Fort, Westinghouse; Dr. J. E. Hobson, Armour Research Foundation, and B. M. Jones, Duquesne Light and Power

Instruments and Measurements

There were two sessions on Instruments and Measurements where a wide variety of subjects were discussed. A. C. Johnson of the E. G. Budd Mfg. Co. for example described the measurement of large varying currents. This involved the use of hollow cylindrical shunts to maintain proportionality of shunt current to measuring current at each instant even at 2 x 10^8 ampere-per-second rates of change. R. E. Kern and S. B. Williams of Curtis-Wright on the other hand discussed the measurement of stress by electrical methods. Most of the discussion at this session, however, was confined to a paper by G. D. McCann, S. W. Herwald and H. S. Kirschbaum all of Westinghouse on electrical analogy methods applied to servomechanism problems. McCann admitted that it was not an exhaustive paper and that only a beginning had been made in studying the steady state characteristics of the mechanisms on the a-c calculating board.

An automatic oscillograph with a memory was described by A. M. Zarem of Cal. Inst. of Tech. In this device photographs of persistent fluorescence records events occurring previous to the opening of the shutter. In discussing this paper it was brought out that two memory types of oscillographs had been built by General Electric since 1939.

There were of course, many other phases of the electrical art which received attention at the convention which cannot be covered in detail here. The sessions on communication for example brought out new developments in telephone and telegraph equipment, in telephone transmission practices, etc. There was a session devoted to sound recording and reproducing at which a new type of phonograph reproducer was described and at which new developments in wire and tape recording were disclosed. Several conferences were held on protective devices; circuit breakers, network protectors, etc. Power system relays formed the topic of a separate session. Discussion at the meeting was directed to the mho relay in system protection as contrasted with the earlier impedance and still earlier reactance relays for long line duty. At the symposium on lighting there was interesting discussion on the need for defined basis of quantitative statement of performance of germicidal lamps. Much progress is being made in the characteristics of glass to allow more ultraviolet energy to come out of the lamp. At present a 30 watt lamp gives off about 6 watts in ultraviolet. In connection with large scale lighting projects, W. A. Pennow of Westinghouse pointed out that spending $15 million on an airport and of that only $15,000 for lighting it was all wrong. Such niggardliness in allowance of money for lighting he said has already caused losses in the millions for wrecked planes not to speak of its toll in human injury and death.

All in all, it was a good meeting. especially if you could manage to be in three places at once.

What the Power Engineer Needs to Know About

THE HYDRAULIC CONVEYOR

Sluice trench . . . Hydraulic jet system for continuously slagging furnaces . . . Features of the hydraulic system . . . Application to coal storage . . . Factors in selecting conveyors . . . Relation to plant size and type

By Wilbur G. Hudson **Consulting Engineer**

DISPOSAL of ashes, either by sluicing at low velocity or in a high velocity stream, has increased rapidly in favor and has certain outstanding advantages. In a mountainside stream material is carried along with the lighter material in suspension and heavier particles dragging along, or perhaps stopping and piling up where the velocity is too low. Similarly if ashes feed continuously as from a chain grate stoker, a flowing stream with just above critical velocity will float or push ashes and clinkers to a sump. If the velocity is too low the stream will dam up. The sump as a rule provides for draining off the water so the ashes can be removed by grab bucket or an elevator with perforated buckets. Infrequently the site may be such that the stream can be spread indefinitely over an adjoining low area which is the ideal system.

Sluice Trench

IN POWER PLANT ENGINEERING (Oct., 1944) mention was made of a plant with four 300 hp boilers where the ashes from chain grate stokers were floated to a sump by a stream about 3-in. deep maintained through a concrete trench. The sluice trench sloped downward slightly and a flow of 300 gpm sufficed to move about 7 tons of ashes per 24 hours. The flow was from a centrifugal pump which recirculated the water with sufficient make-up to reduce abrasive action to within reasonable limits. Of course a ratio of 250 lb of water per pound of ash is nothing to brag about, but simplicity, dustless operation and low maintenance costs made it a very desirable installation. The efficiency will improve as the velocity increases, and in the high velocity jet systems it is stated to approach 5 to 7 lb of water per pound of ash.

Hydraulic Jet System for Continuous Slagging Furnaces

In the modern large plants the ash may accumulate from continuous slag tap furnaces in a water tight sloping floor hopper (Fig. 1) from which, once or twice a day, the water may be drained and the ash removed by a jet nozzle; or molten slag may be disintegrated intermittently by jets; or, as with pulverized coal fired furnaces and chain grate stokers, the granulated ash may accumulate and be flushed out by a hand operated jet. The jet nozzle operates under a water pressure of about 100 psi, giving a nozzle velocity of approximately 130 fps. Ashes and water flush into an open trough where high pressure sluicing jets (Fig. 2) impel the fluid to the disposal point direct, or to a sump from which it is pumped to the disposal point.

Features of the Hydraulic System

The hydraulic system provides dustless operations, safety, and elimination of danger from gas. A jet nozzle discharging 175 gpm will flush ashes from a sloping floor ash hopper at about one ton per minute, and the sluice and booster jets will move the ashes along at that rate when spaced about 60 ft apart, to almost any distance within reason. When a sump is involved, a grid by-passes lumps too large for the pump through a clinker crusher. The pump rotor should be protected by a forced injection of clean water, and usually it is necessary to condition the mixture of ashes and water by additional clean water

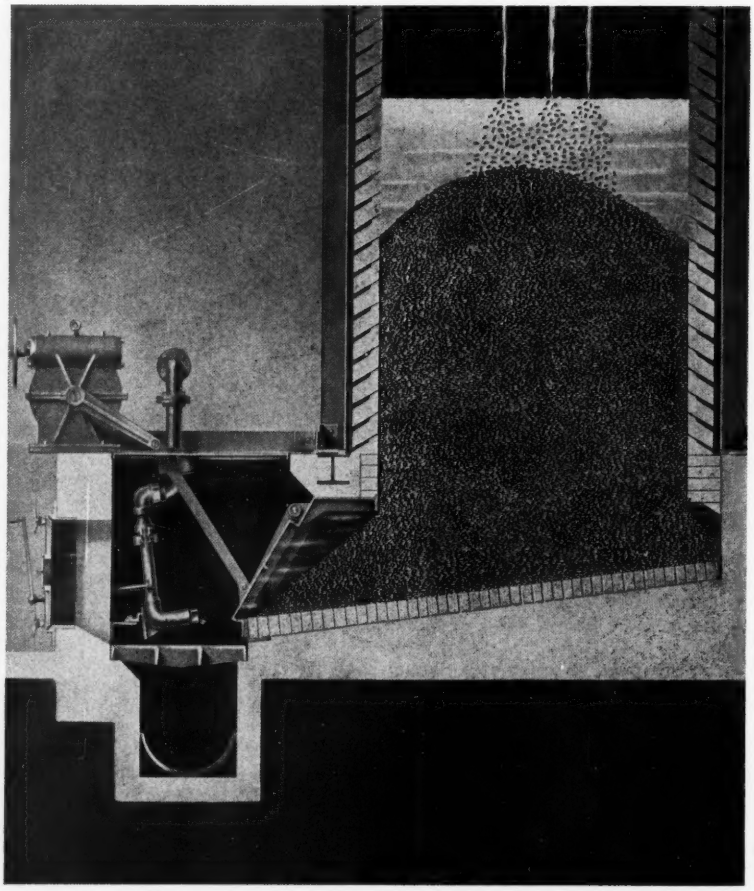


Fig. 1. General arrangement of hydrojet system for continuously slagging furnaces (Allen Sherman Hoff Company)

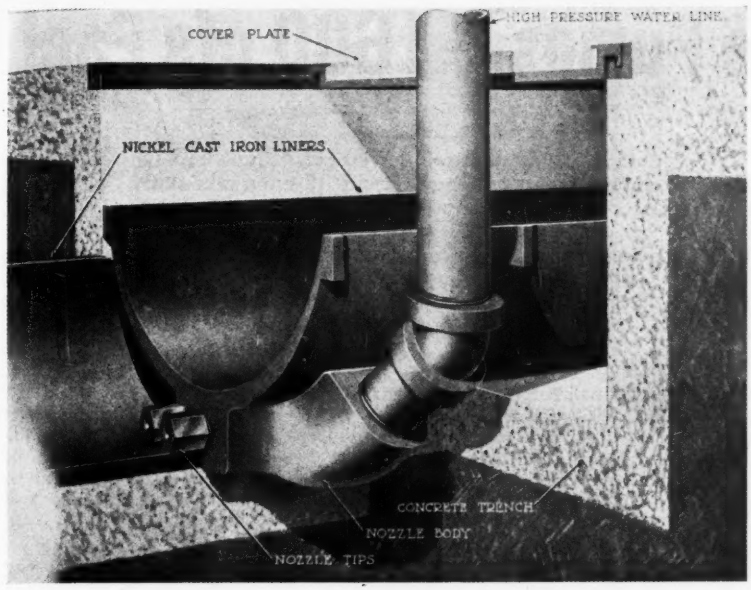


Fig. 2. Stepped trough and jet nozzles

in the sump. The head loss in the disposal pipe with a velocity of 6 ft will usually approximate 3 ft per 100 ft. Thus with a flow of 1000 gpm and a pipe length of 400 ft a 25 hp motor is required. A standby pumping unit should be provided if there is no available emergency method of disposal, since the job of pumping soupy ashes must involve occasional shutdowns for repairs and replacements.

For the small plant a hydraulic ash handling system is not necessarily too costly. An 8 or 10 in. pipe extending along the fronts of the ash pits with intake saddles, as with a pneumatic conveyor, and with a high velocity jet nozzle at the far end, or just behind each intake, will form a rapidly moving floor of water that will carry along ashes and clinkers, and if the distance is not too great, the stream will ascend an incline from basement to ground level.

One interesting application of hydraulic disposal is recalled at a gas producer plant. The producers resembled vertical cylindrical tanks, filled with coal maintained in partial combustion to generate the gas. It is essential that the accumulating ashes at the base of the producer shall be removed without the possibility of additional fresh air leaking in. The base sloped slightly toward a drain at the center. Four tangential nozzles jetted water in narrowing spirals until the water and ashes flowed out down the drain at the center.

Application of the Hydraulic Conveyor to Coal Storage

The hydraulic conveyor has some application to the storage of coal, though it is much better adapted to reserve ground storage than to bin or bunker storage, since the water must be drained off before the coal is usable. Even then it may be difficult to move the damp coal from the bin. For ground storage, if there is a slope so the water will drain from the pile, and if investigation has determined that there will be no legal difficulties as a result of the run-off, a simple movable pipe line provides an inexpensive emergency coal storage system.

If we assume a straight horizontal 10 in. pipe 200 ft long, and a contemplated capacity of 40 tph the coal will constitute about 10 per cent of the water by volume. The volume of coal is 1600 cu. ft per hour, so the volume of water will be 16,000 cu ft per hour, and the total of coal and water is 17,600 cu ft per hour or 293 cu ft per minute. The head loss is 8.8 ft in 200 ft and the weight of the mixture is about 64 lb per cu ft. The theoretical hp is: $(293 \times 64 \times 8.8) \div 33{,}000 = 5$ water hp, i.e., a 10 hp motor.

Of interest, with a pneumatic system the ratio of air to coal by volume would be about 140:1, and the blower motor would be about 30 hp. Incidentally a 16-in. belt conveyor for the same job would require 1½ hp.

Factors in Selecting Conveyors

Consideration of a high pressure hydraulic ash disposal system for the small plant involves careful study of several factors. The pump with motor is a costly unit. If there is a water storage tank at high elevation this possibly may provide a source of pressure, but usually such storage is part of the plant fire protection system and cannot be used. If the open trench—moderate flow method fits in, the investment is much reduced and, except for the additional cost of a sump and disposal elevator, it has good features. Where the ashes can be flushed out by gravity flow direct to the disposal point, the possibilities are obvious.

However, consideration should be given to the alternative of a simple steam jet system. For the small plant the hydraulic ash conveyor has a limited scope of application. For the large plant it quite frequently is considered by power plant engineers to have outstanding advantages.

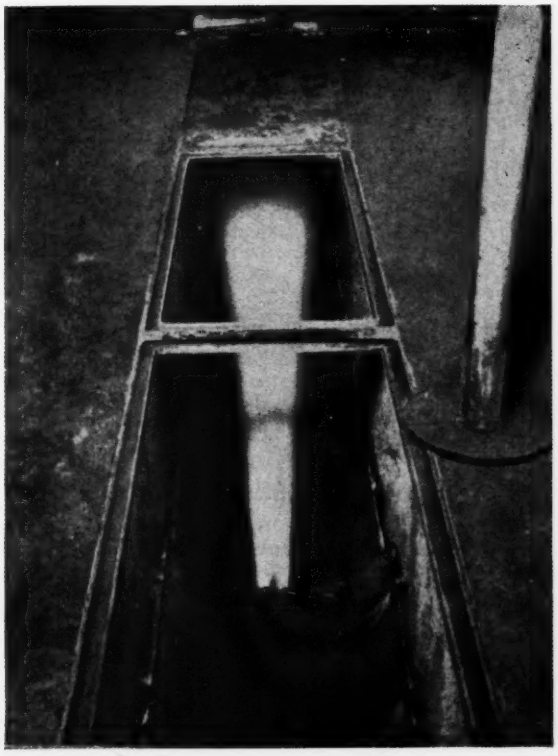


Fig. 3. Sluicing jets in action

Grand Coulee Pumps—1600 cfs Each

By the

Bureau of Reclamation

U. S. Department of the Interior

Initial installation of 4 vertical, single-impeller centrifugal pumps for irrigation pumping; 12 units ultimately . . . Each to be capable of pumping 1600 cu ft of water per sec (100,000 lb per sec) against 270 ft head, driven by a 65,000 hp motor . . . Operated by directly connecting two motors to one of Grand Coulee 108,000-kw generators and bringing the assembly up to speed . . . Pumps being designed on basis of model tests

SPECIFICATIONS for pumps of unprecedented size and capacity, which will lift the waters of the Columbia River to the vast, fertile plateau lands of the Columbia Basin Project in south-central Washington, are being prepared in the office of the Chief Engineer of the Bureau of Reclamation in Denver, Colorado.

Largest reclamation development ever undertaken in the United States, this project calls for ultimate irrigation of nearly 1,000,000 acres of potentially productive land, which will require about 4,000,000 acre-feet of water annually, all of which must be supplied by pumping.

General Design of Pumping Plant

The Bureau plans to call for bids soon on four pumps for the initial installation in the Grand Coulee Pumping Plant, which will provide the supply for the first 400,000 acres to be irrigated. These pumps must be installed before other features of the irrigation project may be put into operation. Ultimately, it is planned that the pumping plant will have a total of 12 pumps.

The pumps will force water stored in the 10,000,000 acre-foot Franklin D. Roosevelt Lake, the reservoir formed by Grand Coulee Dam, into a 27-mile long equalizing reservoir, to be created by constructing earth-fill dams at each end of the Grand Coulee, ancient erosion channel of the mighty Columbia. Water will flow from the equalizing reservoir into the conveyance and distribution systems supplying farm lands.

Electrical energy for operating the pumps will be supplied by the power plant at Grand Coulee Dam. Nearly 1,500,000,000 kwhr of energy will be needed annually for pumping when full development of the Columbia Basin area has been accomplished. As irrigation demands are greatest during periods of flood flow of the Columbia River, secondary or seasonal power will be used largely for pumping, leaving the firm power available for commercial purposes.

Each of the pumps will be capable of lifting 100,000 lb of water a second to a height of 270 ft, and will be driven by the world's strongest electric motors, each 65 000 hp. Each pair of electric motors will be served by one of the 108,000-kw generators at the dam. Specifications for the motors cannot be prepared until the pump design is completed and verified by model tests.

Operating Conditions

Capacity of the pumps will vary according to the seasonal change of water depth in Roosevelt Lake. The level of the lake fluctuates as much as 82 ft, requiring the pumps to be placed below the lowest water level, so that they will operate under positive pressure to avoid the risk of cavitation. At extremely low water, which occurs only about 3 per cent of the time, the pumps will be required to work under a maximum head of 365 ft and each must be capable of delivering 1,170 cu ft of water per sec. However, for about 60 per cent of the time, the lift will be 270 ft and each pump will be expected to handle 1,600 cu ft per sec.

To start the pumps, two of the motors will be connected electrically with one generating unit, the fields

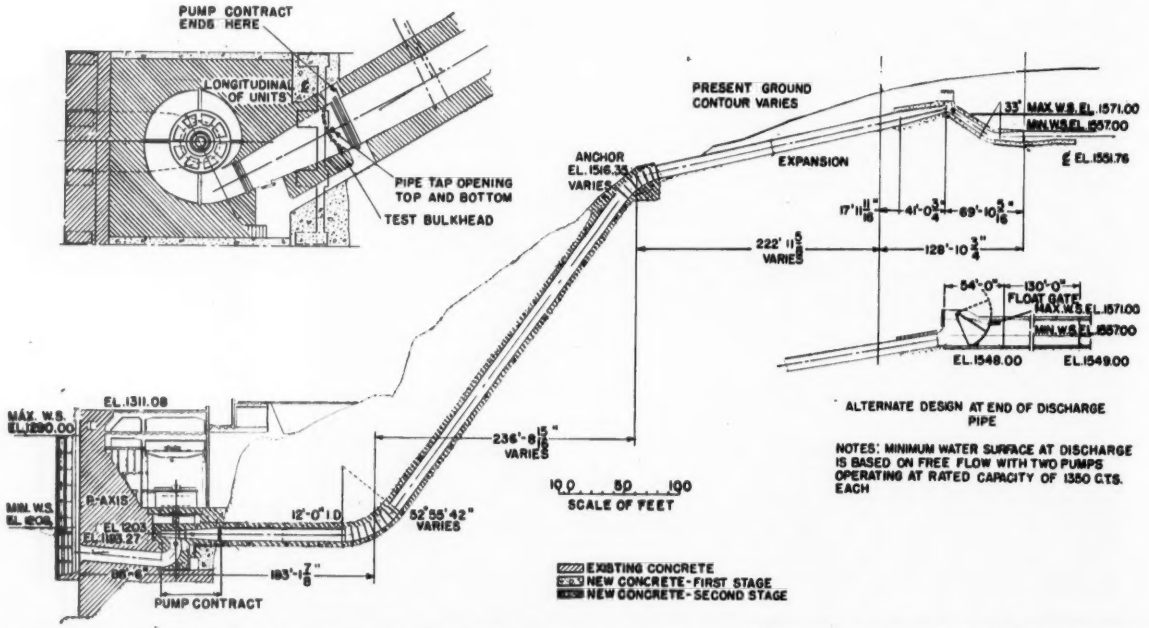


Fig. 1. Typical section through Grand Coulee Pumping Plant showing one of the 1600-cfs pumping units and its discharge pipe

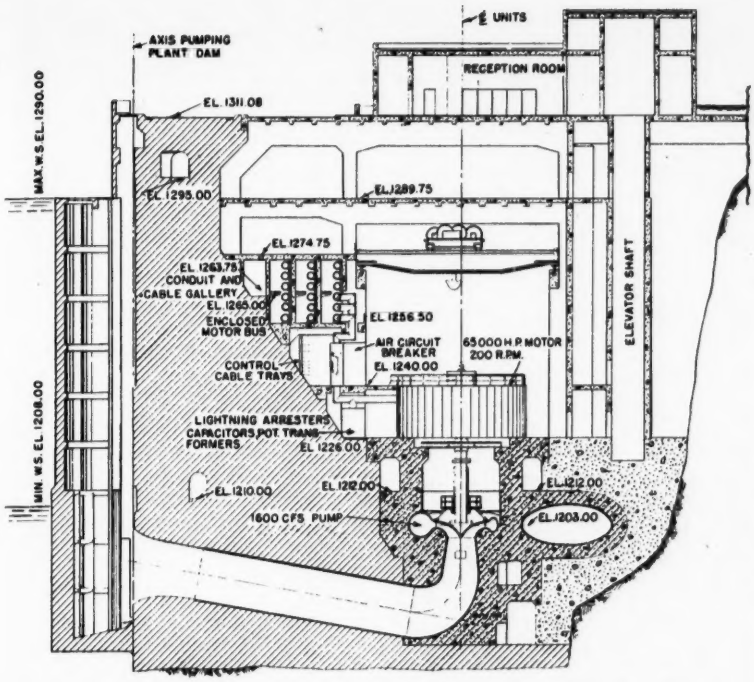


Fig. 2. Detailed cross-section of one of the Grand Coulee pumping units

of the generator and motors will be excited, and the group will be started and brought to full speed together. In stopping, the turbine gates will be closed and the pumping units brought to rest with the generating units.

The pumping plant will be constructed on a shelf which has been excavated from the west canyon wall adjoining the upstream wing of Grand Coulee Dam. When installed in the plant, each pump, complete with motor, will be approximately 50 ft high. In the vertical-drive arrangement planned, the 65,000-hp motors for the pumps will be located directly over the pumps.

Each pump will discharge through a 12-ft diameter pipe approximately 850 ft long into a canal leading to the regulating or balancing reservoir 1.7 miles away. The discharge pipes will be encased in concrete within tunnels drilled in the canyon wall for about two-thirds of the pipe length. Shut-off gates are planned for the entrance to the pump inlet pipes and gates of the floating type or siphons will be provided at the upper end of the discharge pipes. If siphons are installed, each will have an automatic air valve opening for admitting air to break the vacuum if the pump is stopped.

Model Testing Important

Overall efficiency and smooth operation assume special importance in such an unprecedented installation. Thus every feature of the pumping plant, except the pumps, from the intake to the head works of the canal leading to the balancing reservoir has been investigated by means of models to determine the hydraulic conditions. These hydraulic model studies were made in the laboratory of the Bureau of Reclamation in Denver and an extensive research program was carried out in the hydraulic laboratory of the California Institute of Technology for the purposes of developing and verifying the pumping plant design and for determining the hydraulic performance of the unit, the design of the inlet elbow and spiral casing, the limitation of specific speed, as affecting cavitation, and the characteristics of the pumps over the entire range of pumping heads.

The Bureau will require the contractor to build a reduced-scale working model of the pumps for extensive tests to prove the efficiency and dependability of their design. The need of investigations is apparent when comparison is made between the 200-cfs pumps used by the Metropolitan Water District of Southern California for the Colorado River Aqueduct, which are among the largest pumping units built to date, and the 1,600-cfs pumps required for the Grand Coulee plant.

Pump Design Details

The pumps will be of vertical-shaft, single-impeller, single-suction centrifugal type, and will be designed and constructed so that all removable parts, including the impellers, shafts, guide bearing supports, and seal rings, can be taken out from above. The weight of the revolving parts of the pumping units, including any unbalanced hydraulic thrust of the pump impellers, will be carried by the thrust bearings in the motors.

The pump impellers will be approximately 15 ft in diameter, cast in one piece of steel or manganese bronze. Of the centrifugal enclosed type, they will be of sufficient strength to support their own weight plus the weight of the pump shafts when the impellers are resting on ledges in the pump casings.

Pump shafts will be approximately 38 in. in diameter, made of forged carbon or alloy steel suitably heat-treated. The connections between the shafts of the pumps and the motor will be made by means of bolted flanged male and female couplings forged integral with the shafts. Suitable renewable stainless steel or bronze wearing sleeves will be used where the shafts pass through the pump stuffing boxes.

Each pump will have a guide bearing located above the main shaft stuffing box as close as possible to the impeller. The bearings, of babbitt-lined, forced oil lubricated type, will be supported rigidly on the upper pump cover plates. The oil normally will be circulated through each bearing by an alternating-current motor driven pump. A standby oil pump, operated by direct-current motor, will be arranged to start automatically and supply oil to the bearing upon failure of the oil pressure.

Casings and Suction Tubes

The spiral type casings will be of cast steel or welded plate steel construction, and will be furnished in radial sections with flanges for bolting the sections together.

Top and bottom covers and foundation rings will be made of cast steel or welded plate steel. Stuffing boxes, placed where the shafts pass through the top covers and designed for water lubrication, can be readily repacked and adjusted without disturbing bearings.

Renewable seal rings will be provided where there are close running clearances between the impellers and the stationary parts of the pumps. The seal rings on the impellers and on the top and bottom covers will be of corrosion-resistant material of different composition, to minimize damage in the event of accidental contact between rotating and stationary rings, and to prevent deterioration of the rings when pumps are not in operation.

Elbow type suction tubes will have bolted, flanged connections suitable for attachment to the foundation rings. They will be heavily reinforced on the outside by means of ribs or structural shapes and leveling jacks and anchors will be provided to permit centering the suction tubes to the final position in the field prior to the assembly of the foundation rings, casings, and covers. Suction tubes, foundation rings, casings and casing extensions will be embedded in reinforced concrete as shown in the illustrations. The casings and casing extensions are to be held under hydrostatic pressure during embedding.

Application of Electric Motors to Power Station Auxiliaries

By A. E. BEARDMORE

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Part II. Motors for coal handling equipment . . . Necessity for guarding against the entrance of dust . . . Advantages of using totally enclosed motors for coal handling auxiliaries . . . Motors for stoker drives . . . Motors for coal feeders . . . Pulverizer drives

THE AVERAGE STEAM STATION receives its coal either in barges or in cars. Coal dust itself is not particularly injurious to motor insulation, and open squirrel-cage motors have operated very successfully when exposed to it. Open motors will necessarily require more maintenance than enclosed, fan-cooled motors where coal dust conditions are so bad that it is necessary at intervals to clean it out of the windings and the ventilating paths of open motors in order to prevent the motor from overheating because of inadequate ventilation. Many of the newer and better installations of coal handling equipment use totally-enclosed, fan-cooled, squirrel-cage motors or totally-enclosed, fan-cooled, wound-rotor motors. These motors are completely protected against the entrance of dust, dirt, moisture or oil. Consequently, the windings and bearings are entirely clean and free of dust and dirt even though the motor itself may be located in an extremely dirty location. The cooling paths provided in fan-cooled motors for the external cooling air are open and relatively straight, and the velocity of cooling air supplied by the fan is sufficient to keep these cooling paths free of coal dust carried by the ventilating air. Therefore, it is seldom necessary to clean these air passages.

The motor room of a coal tower is usually enclosed, affording ample protection against the weather and coal dust, thus permitting the use of open motors, or open motors and generators if direct-current hoist motors are used. If for some reason the motors are to be used in a dirty location, enclosed, fan-cooled motors should be considered.

Either squirrel-cage or wound-rotor induction motors having at least 200 per cent maximum torque may be used for skip hoist drive. Single-speed squirrel-cage motors are frequently used for hoist speeds of 125 fpm or less, and two-speed motors for higher hoist speeds. Where variable voltage d-c is used in clean locations, an open squirrel-cage motor is used for driving the motor-generator set and an open d-c hoist motor is used. Space heaters should be used to keep the equipment dry, if it is to be idle for any length of time.

The motors driving rotary car dumpers are usually exposed to a great deal of dust, and totally-enclosed, fan-cooled motors should be used for this purpose. If the motors are located in a motor room and well protected from dust, open motors may be used. However, such installations are rather unusual and in most cases, the area near a rotary car dumper is very dusty. Two-speed squirrel-cage induction motors are usually used for the smaller sizes, while wound-rotor motors with suitable secondary control are used for the larger sizes of car dumpers. In some cases, the squirrel-cage motors will have high resistance rotor windings for either the single-speed or two-speed type. In order to determine the proper type of motor and control, it is necessary to make a rather careful engineering study of the entire operating cycle. Therefore, it is suggested that the motor engineers and the engineers of the manufacturer of the car dumping equipment co-ordinate their information in order to make proper motor recommendations.

When selecting motors for conveyor drive, it is necessary to consider the type of conveyors and the operating cycle quite carefully. Conveyors frequently have a high static friction, particularly after they have remained stationary long enough for the oil or grease to become stiff. This condition is aggravated if the equipment is subjected to low temperatures so that the lubricant soldifies or freezes. Usually the equipment runs continuously for several hours at a time, operating at a constant speed, although under certain conditions the conveyor may run for short periods of time. If frequent starts are to be made, this must be taken into consideration in selecting the motor.

In view of the high starting friction, high starting torque, squirrel-cage motors or wound-rotor motors are usually used for conveyor drives. The motors for most conveyor drives should be capable of exerting starting torques of approximately 200 per cent of full load torque. For some installations, a starting torque of less than 200 per cent of normal full load torque may be satisfactory, but certainly before using a motor with less than 200 per cent starting torque the torque requirements should be checked very closely. On other installations where the conveyor carries the coal up a steep grade and is started under loads, it may be desirable to have a starting torque of at least 250 per cent of normal full load torque. Totally-enclosed, fan-cooled motors are usually used, although open motors may operate successfully with more cleaning and maintenance.

Where the conveyors are handling coke or ashes and the motors are exposed to coke and ash dust, which is very abrasive, may be highly conductive, and consequently very injurious to insulation, enclosed, fan-cooled motors should be used.

Where conveyors are chain-driven, precaution should be taken to limit torque peaks because the sudden start of the motor, if thrown on full voltage, may cause a severe whipping action of the chain, particularly if the conveyor is loaded. In some cases, increment starters may be used to apply reduced voltage to the motor in order to take up the slack in the conveyor drive before applying

full voltage. In other cases, wound-rotor motors with several steps of secondary resistance are used. Also in some belt drives, it may be necessary to avoid high torque peaks at the start to keep from slipping the driving pulley on the belt and burning the belt.

Motors for Stoker Drive

In considering motors for stoker drives, comments must be of a quite general nature since the requirements of stokers are many and varied. The motors which drive stokers are invariably exposed to bad ambient conditions, and therefore totally-enclosed or totally-enclosed, fan-cooled a-c or d-c motors are usually recommended. Pipe-ventilated motors are seldom used because of the difficulty of piping clean, cool air to the motor. If the ambient temperature around the motor does not exceed 40 C, a fan-cooled motor rated 40 C rise and using class A insulation is usually used. However, if conditions are accurately known, 55 C enclosed, fan-cooled motors may be used if the rating of the motor is equal to or slightly greater than the maximum load which may be imposed upon it for any appreciable length of time. If the ambient temperature conditions exceed 40 C much of the time, class B insulation should be used.

In the case of traveling or chain grate stokers, the torque required to drive the stoker is practically uniform over the speed range except for a slight increase at low speed, probably in the order of 125 per cent of the torque required to drive it in the middle or upper end of the speed range. Usually, the speed range required of the motors driving these stokers is not exceptionally wide, probably in the order of 4 to 1. Further control of the fuel supply is obtained by changing speeds by mechanical means and by changing the depth of coal on the grates. The type of drive used will depend to a large extent on the frequency and range of speed change required.

In some cases, multi-speed squirrel-cage motors are used, with a change in depth of coal used to obtain variation at any given motor speeds. In other cases, a direct-current motor with a speed range of 4 to 1 by field control may be used, or if a wider speed range is required, d-c motors supplied with variable voltage from a motor generator set may be used. This method of speed control is usually found in large stations where stokers are used for large boiler capacity operating over a wide speed range. In such cases, the automatic station control may be used to operate the generator field rheostat. If variable voltage d-c drive is used for the stoker, care must be taken to see that a motor is selected which will have ample torque and cooling capacity to operate the stoker at the reduced speed point. In addition, it will undoubtedly be necessary to arrange the control to meet the torque

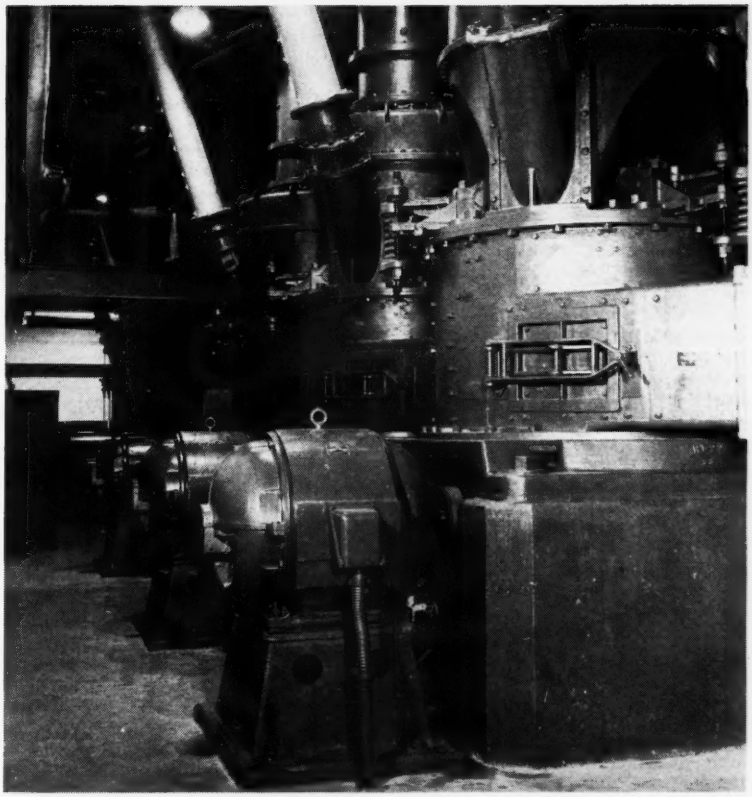

Fig. 7. Three 200-hp, 1200-rpm, 2200-v, 3-phase, 60 cycle high starting torque, drip-proof, 40 C rise, squirrel-cage induction motors driving coal pulverizers

requirement of the stoker instead of providing linear speed change for a constant torque condition.

Over-feed stokers and under-feed stokers have quite similar torque requirements, and careful attention must be paid to securing the right motor for these stokers because the torque characteristics of the stokers fluctuate quite widely. The torque requirements during one cycle of the stoker may vary from 50 per cent of the average full load torque to 150 per cent. Therefore, it is essential that the driving equipment be so designed that it will maintain a relatively constant speed with this wide torque variation during each operating cycle of the stoker. Also, the average torque requirement of the stoker varies quite widely with the speed. Field tests have shown that the torque at low speed may be as much as 175 per cent of the torque at high speed. In selecting a motor for driving these stokers, the rating of the motor must be such that it will have ample horsepower output to drive the stoker at top speed and sufficient torque and cooling ability to operate the stoker continuously at low speed with an increased torque.

If shunt-wound d-c motors are used with speed adjustment obtained by motor field control, it is desirable where several stokers are being controlled from one master control that the motors have a fairly good speed regulation, preferably not over 10 per cent. It is also desirable that all of the motors to be controlled from the same master control have very similar characteristics, so that the speeds of the several motors will be practically the same for any position of the field rheostat. Where d-c motors are used for stoker drives, they should also be of the enclosed, fan-cooled type.

For stokers having a fairly wide torque variation for one cycle of the stoker, i.e., for one revolution of the crankshaft operating the stoker, and also a fairly wide average torque requirement between the high speed and low speed it is recommended that the torque requirement should be obtained from the stoker manufacturer if possible. If this information is not available, the motor selected to drive the stoker should be capable of developing at least 200 per cent torque at the bottom speed.

In some cases, large multi-retort under-feed stokers are driven by constant-speed, squirrel-cage induction motors operating through speed changing devices of a type which provided increased torque at low speed. Hence the motor should have ample capacity for driving the stoker at the full speed condition. Any reduced speed will take less total hp, and since the motor operates at constant speed, the load on the motor at reduced speed will be less even though

the torque required by the stoker increases at low speed.

Motors for Coal Feeder Drive

Motors for driving coal feeders should be totally-enclosed, as these motors are sometimes exposed to an appreciable amount of coal dust, and usually they are exposed to fly ash and other dirt and dust common in a power station, as well as dripping or splashing water. Very likely no one location will involve all of these advance conditions, but in nearly every location coal feeder motors will be exposed to at least one of them. These motors should be rated 40 C rise, regardless of the amount of enclosure, because they may be overloaded by changes in the type or size of coal being handled, or by wet or frozen coal. If a 40 C motor is not available in the type selected for some particular drive, a motor of sufficient size should be selected so that the temperature rise of the motor will not exceed 40 C under the normal operating conditions, in order to provide some leeway for the overload that may occur under adverse conditions. Frequently the coal feeder motor is not exposed to high ambient temperatures, but this point should be checked, as occasionally the equipment may be located directly over the boilers and exposed to a high ambient temperature. If the ambient temperature appreciably exceeds 40 C for many hours per year, class B insulated motors may be justified.

The type of coal feeder motor depends entirely on the feeder used and since the motor is frequently bought with the feeder, the type of motor to be used has already been determined by the feeder manufacturer. In some cases single-speed, constant-speed, squirrel-cage induction motors are used for driving the feeder, and the change in coal feed is accomplished mechanically. In other cases 2-speed feeder motors are used, with the motors changing speeds frequently and, in addition, a mechanical adjustment of the coal feed may also be made.

Where the change in rate of coal feed is accomplished by changing the speed of the feeder motors, totally-enclosed, direct-current motors operating over a wide speed range, usually by variable voltage control, are used. These motors frequently operate over a speed range of 10:1 or more. Wide speed ranges are also obtained by using Thy-mo-trol drives for coal feeders, since this equipment will take power from a standard 60-cycle circuit and provide a speed range in excess of that required by most coal feeders. The subject of coal feeders motors has been treated very briefly in this article because usually the driving motor is selected by the coal feeder manufacturer.

Motors for Pulverizer Drive

From the standpoint of the torque requirements imposed on the driving motor, coal pulverizers may be broadly classified as follows: hammer mills, impact mills, bowl mills, tube mills, conical mills, ring-ball or ball-bearing type pulverizers, and ring or table mills.

Pulverizers known as hammer mills and impact mills are relatively high speed machines, usually having the rotating element directly connected to the driving motor. This rotating element is usually composed of variously shaped hammers or impact paddles which pulverize the material by striking it. These mills should be started empty and require a low breakaway torque, but the rotating elements of the mill are usually quite heavy and have a high WR^2, which may require the use of motors with special rotors capable of accelerating the high inertia. The motors used for driving these pulverizers are usually the normal starting torque, squirrel-cage motors with standard or special rotors.

When selecting a motor for driving one of these pulverizers, the WR^2 of the pulverizer, referred to the motor shaft speed, should be checked with the motor manufacturer to determine whether a standard squirrel-cage motor can be used, or whether it will be necessary to use a motor with a heavier squirrel-cage winding than normal in order to accelerate the high WR^2 of the driven load. The driving motor must have at least 200 per cent maximum running or breakdown torque in order to operate the pulverizer successfully with 70 per cent voltage applied to the motor terminals for a period of approximately one minute, so that the motor will be capable of driving the pulverizer at practically full load speed through voltage dips of momentary duration.

In some cases friction couplings are used between the motor and the pulverizer. This type of coupling allows the motor to come up to speed almost immediately, and a friction device incorporated in the coupling accelerates the rotating parts of the pulverizer after the motor has reached full speed. If this type of coupling is used, the standard squirrel-cage motor can be used in most cases for driving pulverizers having a high inertia.

Hammermills and impact pulverizers are practically always driven at constant speed and squirrel-cage motors started on full voltage are nearly always used for driving them.

It may be well to add a note of caution here. The high starting torque, low starting current type of squirrel-cage motor should not be used for starting a pulverizer requiring a low break-away torque but having a high effective WR^2 at the motor shaft speed, without checking the application carefully with the motor manufacturer. This is because in accelerating a high WR^2, it is necessary to store a great deal of heat in the squirrel-cage winding of the motor and some high starting torque motors may not have sufficient heat storage capacity. Even though it may accelerate the pulverizer quickly, the rotor may be damaged by high temperature after a relatively short period of operation.

Bowl mills have heavy rotating parts but they move at low speed, so the WR^2 referring to the motor shaft is usually not high enough to be a very important factor in determining the type of driving motor. However, the torque required to break the mill away from rest is an important factor in determining the type of motor used. It is common practice to use a squirrel-cage motor developing at least 200 per cent starting torque, although some operating engineers feel that they do not need 200 per cent starting torque and have used normal starting torque squirrel-cage motors for driving the pulverizer. It is suggested that if a motor having less than 200 per cent starting torque is to be used on a bowl-type mill, the torque requirements of the mill as well as the probable voltage condition at the motor terminals should be checked very carefully. This will insure that sufficient torque is available for starting the mill under any operation conditions.

The motors used for driving bowl mills should be started on full voltage and provided with overload relays which will disconnect the motor from the line quickly if it does not start. Otherwise, the high torque motor may be damaged in a few seconds if it remains stalled with full voltage applied to the motor terminals.

Tube mills and conical mills of either the ball or rod type do not require a high torque to break them away from rest, but the motor must be capable of developing a torque of approximately 120 per cent of full load torque at very low motor speed. Right after cascading begins, which occurs as soon as the mill has turned through approximately the first one-third revolution, the torque decreases from approximately 120 per cent to less than full load torque, and, in the case of most of the newer installations, then builds up gradually to full load torque at full speed.

While tube mills and conical mills are large, the effective WR^2 at the motor shaft is not very large because the mills themselves operate at a very low speed, probably in the order of 19 to 21 rpm. Usually the normal starting torque, normal starting current squirrel-cage motors will have ample starting torque to start the mill from rest and bring it up to speed. These motors should have at least 200 per cent maximum running torque to permit them to operate successfully through voltage disturbances where the voltage may go down to as low as 70 per cent of normal voltage for one minute.

The ring-ball or ball bearing type of pulverizer also has very heavy rotating parts, but they move at slow speed so the effective WR^2 at the motor shaft speed is usually small

(Continued on page 126)

How to Prime Centrifugal Pumps*

By Roy Carter *Application Engineer, Worthington Pump and Machinery Corp.*

Part I . . . The first of a series of three articles giving complete details of a subject on which there is very little information in the textbooks or in the usual discussion of centrifugal pumps . . . This part covers manual priming and the various vacuum-producing devices for priming . . . When and how to use foot valves . . . How to use priming chambers . . . Ejectors . . . Dry and wet vacuum pumps for priming . . . Part II will describe central priming systems and the various types of automatic priming devices . . . Part III will take up self-contained automatic priming units and discuss systems for specific installations

PRIMING a centrifugal pump means removing the air, gas or vapor from the waterways of the pump by filling these spaces with the liquid to be pumped. This can be done manually or automatically, depending upon the equipment and controls used.

To one familiar only with positive displacement pumps of the reciprocating and rotary types, it might seem strange that a centrifugal pump could not prime itself, because those displacement types, if properly sealed, will pump air as well as liquid and will, therefore, exhaust any air in the suction line. Centrifugal pumps will also pump air, contrary to most people's understanding, but because of the low gravity of air, the actual pressure developed when pumping air is very small.

Thus a centrifugal pump, running at its normal speed, can produce very little vacuum measured in feet of water. For example, a pump which develops 200 ft head handling water would likewise develop 200 ft head when handling air, but a head of 200 ft of air is only equivalent to a vacuum of approximately 3 in. measured in terms of a water column, obviously too little for priming any usual pump installation.

With Positive Suction Head, Only Venting Is Needed

When first put in service, the waterways of a centrifugal pump are filled with air. If the suction supply is above atmospheric pressure and the suction valve is opened, this air will be trapped in the pump and compressed to some extent. Unless the suction pressure is high enough to compress the air so that the suction waterways and the eye of the impeller are filled with water, the pump will not be primed; hence this entrapped air must be removed. With a positive suction head on the pump, priming is accomplished by venting the entrapped air out of the pump through a valve provided for that purpose.

If the pump takes its suction from a supply located below the pump itself, the air in the pump must be evacuated by some vacuum producing device, a foot valve must be provided in the suction line so the pump and suction piping can be filled with water, or a priming chamber must be provided in the suction line.

Foot Valves

Foot valves were very commonly used for early installations of centrifugal pumps but now, except for certain applications, are relatively little used. A foot valve, shown in Fig. 1, is a form of check valve installed at the bottom or foot of a suction line. Like a regular check valve, its purpose is to allow flow in one direction only, that is, towards the pump. When the pump is stopped, the ports of the foot valve close and, if it seats tightly, the water cannot drain back to the suction well.

Unfortunately a foot valve does not always seat tightly, so the pump occasionally loses its prime. In such a case, the rate of leakage is generally small and it is feasible to put the pump into service by filling it and starting it promptly. This uncertainty of a foot valve installation, especially when the water contains small particles of foreign matter like

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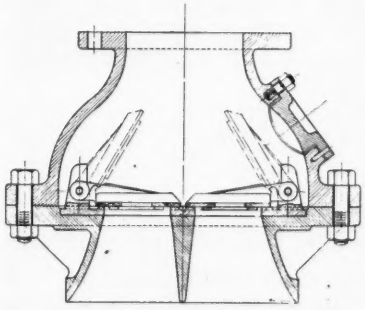

Fig. 1. Section of foot valve (Worthington Pump & Machy. Corp.)

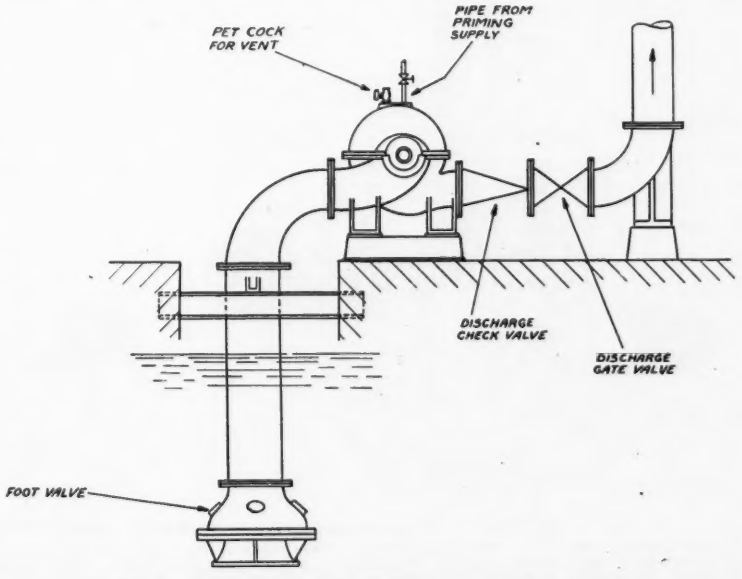

Fig. 2. Typical foot valve installation on centrifugal pump

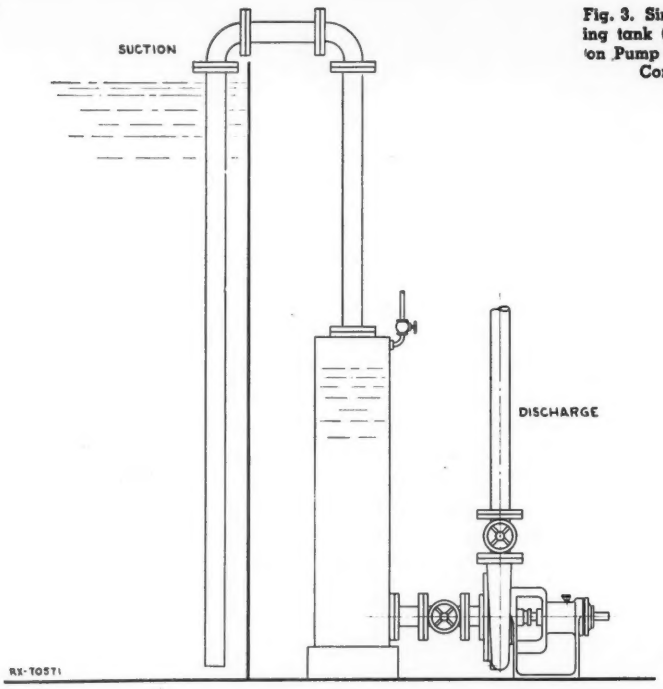

Fig. 3. Simple priming tank (Worthington Pump & Machy. Corp.)

sand, has been a major factor in the reduction in the number used. Foot valves should not be used for liquids containing foreign material. Because the friction losses through foot valves are usually high, they are undesirable for that reason also. To keep the friction loss within reasonable limits, a foot valve with a large port area is necessary. Unfortunately the size of the pipe connection is not a true indication of the area through the ports of the valve.

A typical installation of a pump with foot valve is shown in Fig. 2. The pump can be filled with water through a funnel attached to the priming connection or from an overhead tank or other source of water. If a check valve is used on the pump and the discharge line remains full of water, a small by-pass around the valve permits using the water in the discharge line to re-prime the pump if the foot valve has leaked. In priming a pump equipped with a foot valve, provision has to be made so all the waterways can be filled and the air vented out. The actual point at which water is introduced into the waterways is of no importance but usually it is done at the priming connection provided on the top of the pump casing, shown in Fig. 2.

When the discharge head is low, the discharge check valve is often eliminated and the foot valve acts as a check valve to prevent reverse flow through the pump. As most foot vales are designed for relatively low pressures, the use of a foot valve as a check valve for the system is not generally practicable with systems having a high discharge pressure. In such an installation, a discharge check valve is necessary but there is always the danger that the check valve will not seat tightly while the foot valve does, thus subjecting the foot valve to the static discharge pressure. On a system where the water can drain out of the pump through the discharge line when the pump is shut down, it is necessary to have a discharge gate valve, which must be closed when the pump is to be stopped and opened after it is started.

Priming Chambers

A priming chamber in its simplest form is a tank with an outlet at its bottom at the same level as the pump suction nozzle and directly connected to it and with an inlet located at the top of the tank to which the suction line is connected as illustrated in Fig. 3. The size of the tank must be such that the volume contained between the top of the outlet and the bottom of the inlet is roughly 3 times the volume of the suction pipe. With a priming chamber, leakage of air while the pump is shut down may cause the liquid in the suction line to leak out but the liquid in the tank

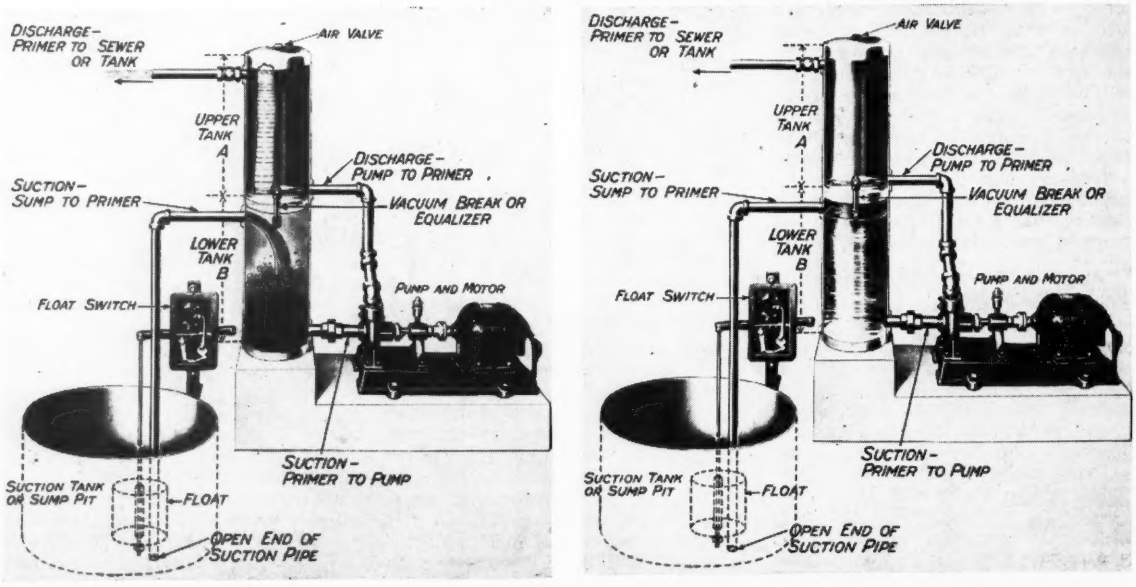

Fig. 4. Installation of a commercial priming tank, showing method of operation. (Valve & Primer Corp.)

A (Left)—Priming tank in use with pump running. When pump starts, it draws liquid from lower chamber, discharges it through upper chamber. Withdrawal of liquid from lower chamber causes partial vacuum in chamber, hence liquid in sump or well flows into chamber and thence to pump. B (Right)—Priming tank in use with pump stopped. When pump stops, liquid from upper chamber runs back into pump and into lower chamber, by gravity, thus refilling them and keeping the pump always ready for starting

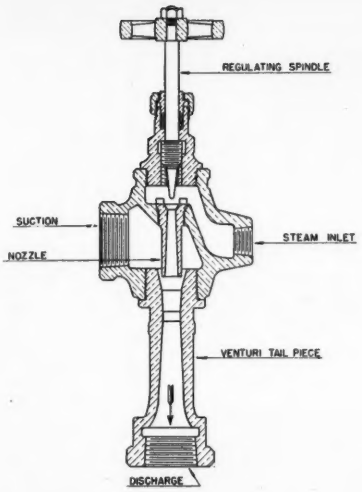

Fig. 5. Section of a steam jet primer (Schutte & Koerting Co.)

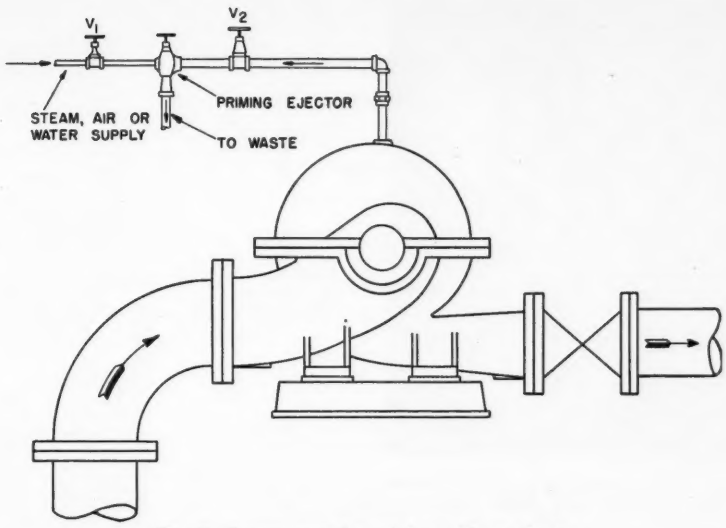

Fig. 6. Arrangement for priming with an ejector

below the suction inlet cannot run back to the supply. If the centrifugal pump is then started, it will pump this entrapped liquid out of the chamber, creating a vacuum in the tank and the atmospheric pressure on the supply will force the liquid up the suction line into the priming chamber.

Certain precautions must be taken in the design to prevent vortexing at the outlet of the chamber and to prevent syphoning when the unit is shut down. Except in special cases, it is more advantageous to buy a commercial priming chamber with proper automatic vents and other features, than for the user to attempt to make his own design. The use of priming chambers is restricted, because of their size, to relatively small pumps. Figure 4 shows a well known design of priming chamber with automatic features which makes it more satisfactory for most installations than the simple tank shown in Fig. 3.

Types of Vacuum Devices Used

For systems in which pumps are primed by evacuating the air, practically every commercially made vacuum producing device can be employed. Formerly water and steam jet primers were applied widely, but with the increase in the use of electricity as a source of power, motor driven vacuum pumps have become popular. The wet-type vacuum pumps are most favored for manually-controlled electrically-driven units, because no damage will result if slugs of water are carried over into the vacuum pump. When dry-vacuum pumps are employed, some protective device must be interposed between the centrifugal pump and the vacuum pump so that water cannot get into the vacuum pump. The dry vacuum pump is used extensively for "central priming systems."

Ejectors

Priming ejectors work on the jet principle using steam, compressed air, or water as the operating medium. In the case of steam or compressed air, the steam or air is discharged at high velocity into the throat of a venturi tube carrying with it some of the surrounding air and forcing the combined mixture out of the tail piece of the venturi. See Fig. 5. A high vacuum can be produced by both steam and water ejectors. Water ejectors are constructed like steam ejectors except that when the actuating water pressure is low, multi-jet nozzles are used.

A typical hook-up for priming with an ejector is shown in Fig. 6. Valve V_1 is opened to start the ejector and then Valve V_2 is opened. When all the air has been exhausted, water will be pulled over and will be discharged by the ejector. When this occurs the pump is primed and valves V_2 and V_1 are closed in that order.

An ejector can be use for a number of pumps if connected to a header to which the individual pumps are vented through isolating valves.

Dry and Wet Vacuum Pumps

Dry vacuum pumps, which are made both in the reciprocating and rotary type, are designs which cannot handle mixtures of air and water. When used on priming systems, the system has to be arranged so no liquid can get to the vacuum pump.

Any rotary, rotative or reciprocat-

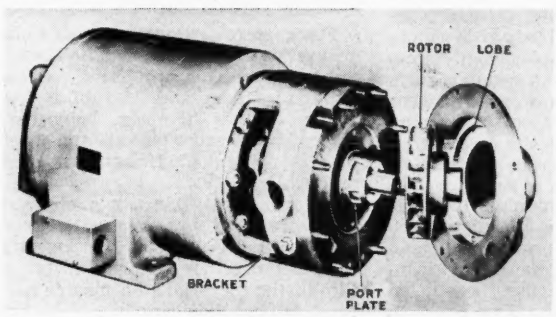

Fig. 7. View of a partially disassembled Nash pump (Nash Engrg. Co.)

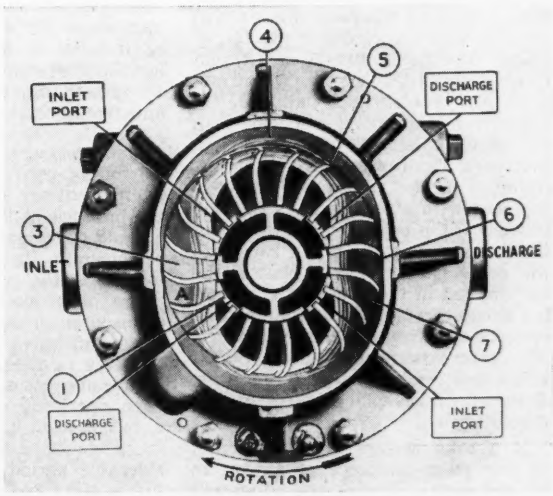

Fig. 8. Diagram showing principle of operation of Nash pump (Nash Engrg. Co.)

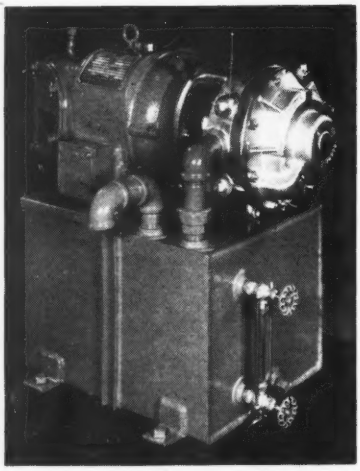

Fig. 9. Nash priming pump with sealing liquid reservoir base (Nash Engrg. Co.)

Fig. 10. Portable pumping unit with hand primer (Worthington Pump & Machy. Corp.)

ing pump that can handle air or a mixture of air and water is classified as a wet vacuum pump. The most common type used in priming systems is the Nash Hytor pump shown in Figs. 7 and 8. The Nash vacuum pump is a centrifugal displacement type of pump consisting of a round, multi-blade rotor revolving freely in an elliptical casing partially filled with liquid. The curved rotor blades project radially from the hub and form, with the side shrouds, a series of pockets and buckets around the periphery.

The rotor revolves at a speed high enough to throw the liquid out from the center by centrifugal force, resulting in a solid ring of liquid revolving in the casing at the same speed as the rotor, but following the elliptical shape of the casing. It will be seen that this alternately forces the liquid to enter and recede from the buckets in the rotor at high velocity.

Referring to Fig. 8 and following through a complete cycle of operation in a given chamber, we start at point A with the chamber (3) full of liquid. The liquid, due to centrifugal force, follows the casing, withdraws from the rotor, and pulls air in through the inlet port, connected with the pump inlet. At (4) the liquid has been thrown outward from the chamber in the rotor and has been replaced with air or gas. As rotation continues, the converging wall (5) of the casing forces the liquid back into the rotor chamber, compressing the air trapped in the chamber and forcing it out through the discharge port, connected with the pump discharge. The rotor chamber is now full of liquid and ready to repeat the cycle. The cycle takes place twice in each revolution.

If a solid stream of water comes to this pump in place of air or an air and water mixture, the pump will not be damaged, but will require more power to drive. For this reason, in automatic priming systems using this type of vacuum pump, a separating chamber or trap is provided so the water will not reach the pump.

Sealing Water Supply

Water needed for sealing a wet vacuum pump can be supplied from a source under pressure, for instance, from a city water supply or from some adjacent tank. When water is taken from a pressure supply, the amount of the flow is regulated by a throttle valve, while the flow is controlled by some separate shut-off valve so the adjustment of the throttle valve need not be disturbed. The shut-off valve can be manually or solenoid operated. In the latter case, its operation is tied into the motor control.

If no pressure water is available or if it is desired to have the system independent, the vacuum pump can be mounted, as shown in Fig. 9, on a base containing a reservoir from which the sealing water is taken and into which the pump discharges its mixture of air and water. This type of installation is very desirable in locations where freezing may occur, for the sealing can be done with some anti-freeze solution.

Hand Primers

Hand primers formerly were quite commonly used to prime centrifugal pumps, but are seldom used in modern practice. A hand primer is simply a hand-operated displacement pump as shown in Fig. 10. A common form used was the old fashioned pitcher pump, often mounted on the priming connection on top of the casing with a shut-off valve interposed.

Check on Tightness of Suction Line

In some cases, a pump which has been operating on a lift and which does not have a foot valve, will hold its prime when shut down for a considerable period because the suction line is tight and the stuffing box is in good condition and properly adjusted. Such units can be restarted as they are fully primed. The time in which a pump loses its prime is a measure of the tightness of the suction line and the condition of the stuffing box. If a pump loses its prime quickly, the suction line should be checked for leaks and the stuffing boxes should be inspected.

(To be continued)

Relief Valve Application—Correction

ATTENTION IS CALLED to typrographical errors which inadvertently were printed in the article "Relief Valve Application" page 130 of the December, 1945, issue of POWER PLANT ENGINEERING. To prevent misuse of the formulas, it is suggested that readers correct their copies of the December issue as follows:

Transpose the closing parenthesis in the formula for K appearing near the bottom of column three, page 130, so it will read:

$$K = \text{a constant equal to } 0.000131 \left(1 + \frac{3.6}{d}\right) 2 P_2 V_2 \div 3600 d^5$$

On page 132, column two, line three, should read:

REFER TO STEP FIVE: $P_2^2 = 216$.

EDITOR.

FIBER REED FURNITURE made of strong twisted paper is sized with animal glue. This protective coating imparts exceptional durability to paper. Clothes hampers, baby carriages, waste paper baskets and other pieces may be made from this treated material.

CALCIMINE IS BASICALLY a physical structure held together with glue. The glue not only holds the powdery material together but will fasten a film of the material to a plaster surface. Animal hide glue is used in hot water calcimine and bone glue in cold water materials.

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

THE EFFECT OF THE ATOMIC BOMB ON OUR CIVILIZATION

Speculation concerning the use of nuclear energy for peacetime power purposes though interesting are of secondary importance to the question of what we are going to do with the atomic bomb. The time we have for setting our house in order is short, five, ten, twenty years, it doesn't matter. Regardless of whether we try to keep the principles of the atomic bomb secret or not, other nations will have the bomb in a short time and unless we do something to prevent an atomic war, all our technology leading to the peacetime use of nuclear energy will be of little avail; in the end it will destroy us

By Andrew W. Kramer ***Managing Editor, Power Plant Engineering***

SINCE the atomic bombs were dropped on Hiroshima and Nagasaki last August there has been much discussion of the application of atomic energy to peace time use. This is quite natural. The availability of U235 or PU239 on a mass production basis with high but definitely reducible costs opens interesting fields of speculation regarding its use for power purposes. In the fission of uranium we have a fuel—a fuel so enormously concentrated that all ordinary fuels are rendered insignificant by comparison except on the basis of cost. When we burn coal we obtain an energy release of anywhere between 10,000 and 12,000 Btu per pound. In the case of uranium 235 the energy released is about 11,400,000 kilowatt hours (approx. 39 billions of Btu) for each pound of U235 split. At present, the price of U235 is probably very high. The actual production costs are, of course, secret. However, various estimates have been made regarding the cost of U235 to enable it to compete on an equal basis with existing fuels such as coal, oil and gas. These range from $52,000 per pound of U235 for aviation gas at 20 cents to $9000 per pound for coal at $6.00 per ton.

Nuclear Power an Accomplished Fact

As far as the possibility of a control release of atomic energy for power purposes is concerned this does not have to be proved. It is an accomplished fact. The Hanford Plant in Washington was not built to generate nuclear energy. Its purpose was to synthesize plutonium to make atomic bombs. The production of heat in this reaction was not merely incidental, it was a positive drawback in the program to make as much plutonium as possible. As already mentioned in preceding articles, the production of as little as one kilogram of plutonium per day—that is 2 2/10 pounds—results in a heat release of around 1½ million kilowatts. When we consider that the ultimate power capacity of the Grand Coulee power development is around 2 million kilowatts, the power implications of atomic fission become evident. At Hanford the heat was wasted in heating up the Columbia River, but it is evident that it might just as well have been used to heat water in a boiler. This step involves only engineering technique; it involves no new scientific concepts. As to the operation of the Hanford Plant, it is unusually smooth running. Speaking before the American Society of Mechanical Engineers on January 30 in New York, Dr. John Archibald Wheeler, Associate Professor of Physics, Princeton University, said, "I have just returned this afternoon from the atomic energy plant of the Hanford Engineer Works located near Hanford, Washington. I have followed this plant from its start up on September 26, 1944, over the period of the past 16 months and can say that the possibility of the controlled release of atomic energy is an accomplished fact. I can testify to you that one could not ask for a plant which is quieter, smoother running or more reliable."

So far as building a nuclear energy power plant is concerned, that can be done in a very short time, if we want to do it. The question of economics, of course, is another matter, and as indicated above, that requires further development in the process of finding new uranium deposits, further economies in the refining of ores, improving the technique of handling, and, of course, in the production of plutonium itself. Just now it is not a question of whether uranium costs $52,000 a pound or $9000 a pound. The fact remains that if we want to build a nuclear energy power plant, we can begin to design it almost at once.

Speculations Regarding Power of Secondary Importance

These speculations concerning the possible use of nuclear energy for power purposes, however interesting and important, do not compare with

ATOMICS

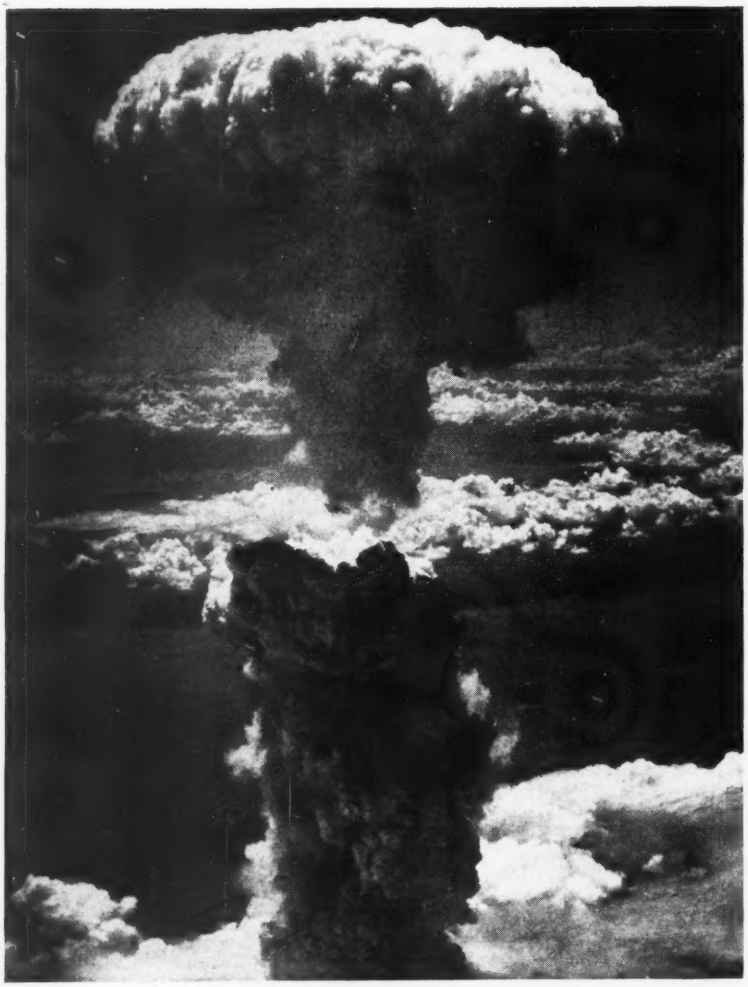

Fig. 1. A view taken over Nagasaki a few moments after the atomic bomb exploded. This view shows how the smoke billowed upward. Driven with such volcanic-like force that it ascended almost in a straight line upward, the smoke did not begin to billow out until it had passed through cloud layers at 20,000 ft. Acme Photo

the fundamental importance of the atomic bomb itself. Unless we can set our house in order regarding the use of the atomic bomb itself, it is of little consequence whether we can or can not harness nuclear energy for peace time use or whether it is economical or not so. The atomic bombs which were dropped on Hiroshima and Nagasaki by our Super Fortresses destroyed everything within a radius of a mile or a mile and a half. Even from a purely economic standpoint, the dropping of these bombs rendered TNT and all of our other high explosives obsolete. Expensive as the Manhattan Project was, the achievement of the atomic bomb vastly cheapened the cost of destruction. Whether it costs $5000 a pound or $50,000 a pound U235 is now the cheapest explosive we have.

We know, however, that the progress of research will result in cheaper processes using more abundant materials and less conspicuous installations producing more powerful explosions and more deadly rays. These bombs of the future may be sent by carriers which for all practical purposes are invisible or at least untouchable. As Robert Maynard Hutchins, Chancellor of the University of Chicago, pointed out recently[1], some idea of the rate of increasing destructiveness to which we may look forward may be gathered from the statement that the "improvement" if the word may be used in this connection, from the Hiroshima bomb to atomic explosions that would devastate the entire United States, is a much smaller improvement than that made this year in the development of nuclear explosives.

In 50 years we shall probably be able to start a chain reaction which will blow up the globe. Whether that would be a good thing or an unfortunate one, depends upon your point of view; whether you are a pessimist or an optimist. Even now development in the rate of nuclear research is going ahead at an enormous rate. Within the last few days the General Electric Research Laboratory has announced a plan for producing X-rays of one billion volts; what this development may lead to nobody can tell. But if the history of scientific research is any criterion, it is bound to lead to achievements of great importance.

Can we keep secret of the Atomic bomb?

We cannot take refuge from these speculations by assuming that we possess secret scientific knowledge that will protect us. As was indicated in the preceding article, even with the information released in the Smyth Report, it is quite possible for any person with some scientific or mechanical training to devise an atomic bomb which might work. Whatever secret there was about the atomic bomb was disclosed when the first bomb was dropped. The news had scarcely been released to the newspapers before thousands of people throughout the world knew quite clearly how the bomb worked. Of course, they did not know the exact mechanical details but the principle of the bomb was fairly well evident. In fact, it was evident even before 1942. The War Department, by releasing the Smyth Report, has given away all that we know up to 1942 and some of what we learned afterwards, and this shows other nations the path which they must follow to reach the point at which we had arrived in 1945. The discussions of whether other nations will be able to make atomic bombs and whether we can prevent them from doing so by keeping ours secret has bordered on the absurd.

Dr. Irving Langmuir of the General Electric Company, after his recent visit to Russia, stated before a Congressional Committee in Washington that he thought Russia would be able to make atomic bombs in something around three years. In fact, he stated that they would probably be able to accumulate them faster than we could. It makes no difference, however, from the standpoint of survival, whether Russia or any other country in the world can make atomic bombs in three years, or ten years or even twenty years. The important point is that they will be able to make atomic bombs in a very short time. When that happens, the cities and industrial plants of the United States will be open to the same destruction as that which befell Hiroshima and Nagasaki.

Secrecy, therefore, is against our interests. Indeed, our secrets do not amount to very much. As a matter of fact, we never would have had the bomb if the work of scientists, in-

ATOMICS

[1] Human Events Pamphlet No. 1. Human Events, Inc., 608 S. Dearborn St., Chicago, Ill.

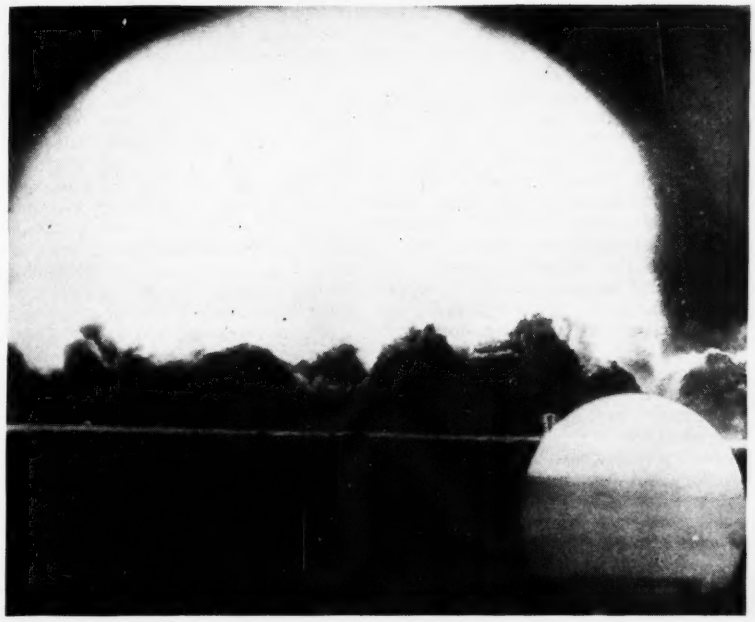

Fig. 2. (Left) A view taken at a distance of six miles of the explosion of the experimental atomic bomb at Alamogordo, New Mexico, on July 16, 1945. The bomb exploded with a blinding flash, lighting up the area brighter than the brightest daylight. The black clouds below are clouds of dust sucked up from the desert by the upward effect of the blast

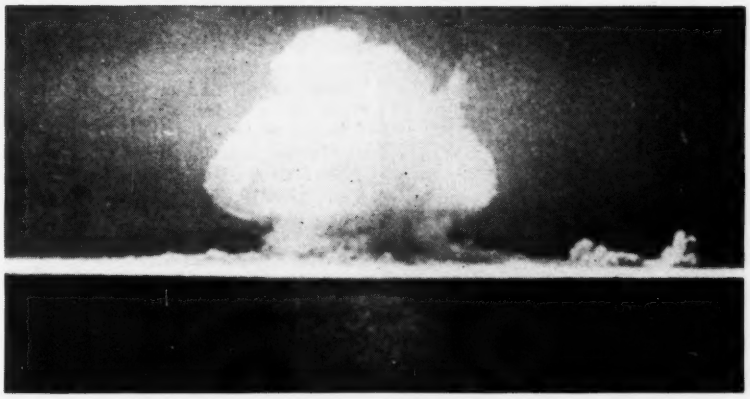

Fig. 3. (Below) Another view of the explosion in New Mexico taken a little later than the one shown in Fig. 2. At the bottom white hot clouds of life destroying gas spread out over the horizon. Acme Photo

cluding those in enemy countries had not been available to us. It should be remembered that it was Dr. Hahn in Germany who made a great step forward in 1939 when he showed that ordinary elements like barium, krypton and iodine were formed when uranium was bombarded by neutrons. At that time, despite the gathering clouds of war over Europe, there was still a free flow of scientific information across international boundaries. The news of Hahn's discovery was relayed to the United States late in January, 1939, by Professor Bohr and within a very short time the fission of uranium was demonstrated in many laboratories not only in this country, but throughout the world. This knowledge alone should make it obvious that despite our development of the atomic bomb, we shall not be able to take the next steps that will be required either in the peaceful or military use of atomic energy unless there is a free flow of scientific information throughout the world. Even at the present time it is being implied that we are lagging in nuclear research behind that of Russia. Whether this is true or not makes no difference. The point that is important is, that there should be an interchange of knowledge regarding nuclear physics between all the countries of the world. We, of all nations, have the least to fear and the most to gain from the free flow of information because we have the industrial power to make the most of any scientific ideas that appear.

What about the supply of uranium?

As far as the supply of natural uranium in the world is concerned, this offers as little hope of keeping the bomb for ourselves as the idea of secrecy. Merely because most of us have never seen any uranium we must not assume that it is a very rare metal inaccessible to many and expensive to all. Uranium is about as abundant as copper, but its occurrence in high-grade ores is not common. There is, however, enough uranium available to blow up all the cities of the world and with the increased demand, prospectors will redouble their efforts to find new deposits. It is well to remember that the two largest uranium deposits, those at Great Bear Lake in Canada and those in the Belgian Congo were discovered accidentally in the last 20 years. Uranium has always been more or less of a rare metal but there never was any great use for it, and as a consequence, it has offered no incentive to prospectors to find it. Today the condition is entirely different. Overnight it has become the most valuable material in the whole world and it is to be expected that great efforts will be made in every part of the world to find new and richer deposits.

Cost

Much discussion has revolved around the cost of the atomic bomb. The two billion dollars spent on the Manhattan Project as a whole is always mentioned. Two billion dollars is a large amount of money judged by any standard; but still it is small compared to the cost of a war—especially a war such as we have just been through. A recent computation placed the cost of the war near 1400 billion dollars with China not included. Of this staggering total, more than one fourth was incurred by the United States of America. The two billion dollars spent for the bomb, therefore, is relatively insignificant compared to the 300 or more billions of dollars which we contributed to the cost of the war. But it must be remembered that under the pressure of time we were required to follow many simultaneous courses of action many of which led to blind alleys. All of the false starts and unworkable schemes are well known now and other nations engaging in the development of atomic

bombs can and will profit from our experience.

Only defense is not to be there when it goes off

Finally, there is no defense against the atomic bomb. General Groves, who headed the Manhattan Project, said, "The only defense against the atomic bomb is not to be there when it goes off." It will, however, not be

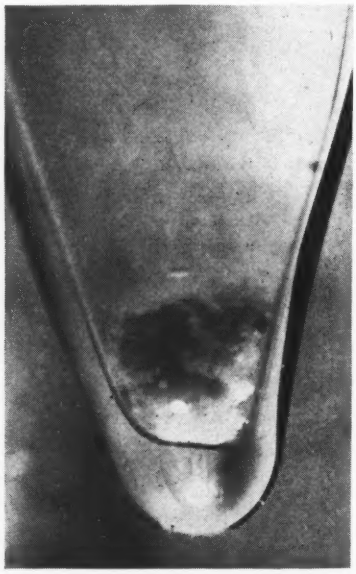

Fig. 4. Twenty micrograms of pure plutonium hydroxide, produced at the Metallurgical Laboratory of the University of Chicago, is shown as a cloudlike mass at the bottom of a test tube. The bright green substance was produced from uranium with neutrons from the cyclotron by Dr. Glenn Seaborg and two assistants, B. B. Cunningham and L. B. Werner. Acme Photo

given to us to know when or where it is going off. While we have defenses against airplanes carrying bombs, it is unlikely that airplanes in the ordinary sense will be used. Rockets will be used and these probably will be guided to their targets by radio.

In thinking of airplanes and rockets, however, we are displaying our traditional tendency to conform to old ways of doing things. With the atomic bomb all notions of carriers can be disregarded because the cheapest and most effective way of blowing up an enemy city is to send agents into them in peacetime and plant bombs in strategic locations and then detonate them when war is decided upon. With this method we need never know who the enemy was until it was all over and then it would be too late. It may well be, however, that in such an attack the aggressor nation might also have its city destroyed and it would be difficult to determine who won the war. As a matter of fact, we have some difficulty now in determining who won the last war.

The aggressor nation will, of course, at a given signal destroy the cities of the enemy simultaneously. The nation so attacked, however, would also have planted bombs in the cities of the aggressor nation or would have placed its atomic weapons in remote regions of its own country out of reach of the attacking bombs and thus would retaliate at once by blowing up the cities of the aggressor. In a short space of time, therefore, perhaps an hour or two the cities of both nations would have been completely destroyed.

It may be suggested that the very hopelessness of this situation will prevent its realization but the course of history does not make this prospect very encouraging. The horror of war has never prevented wars. After each war it is said that the next war will be so horrible that nobody would want to start it but wars have been recurring ever since the dawn of what we choose to call civilization. An atomic war will probably be no worse as far as the individual is concerned than previous wars, except that it will be faster. Instead of taking five or six years to kill four or five million people, we will kill fifty million people in say an hour.

Is the situation then, utterly hopeless? Not entirely, and here we can do no better than again to turn to Dr. Robert Hutchins.[2] "The only hope," says Dr. Hutchins, "is to increase the rate of moral progress tremendously—to increase it beyond anything we ever dreamed of—to increase it to an extent which at first glance may seem hopeless.

"We know that we have a certain amount of time before the world will be full of atomic bombs. We probably have not more than five years before some other country has them. We know that the next five years will be used to make more and more deadly atomic explosives. We must see to it, if we can, that our social and cultural advances for once exceed the advances in the technology of destruction. The survival of mankind demands a world community, a world government and a world state.

"The tone and content of international negotiations during the next five years should be such as to allay mistrust. Everything should be done to remove or diminish fear among nations and nothing should be done to cause or increase it. We should not begin to swagger because we have the bomb, others will have it soon. We should not use our temporary strength to bargain on minor points or to push other countries around. We may create animosity for which we shall pay dearly in the atomic age. We should take measures that will reveal our good will and our eagerness to cooperate with other nations. We should take no measures which will promote friction or distrust. One of the measures best calculated to allay mistrust would be to disclose the so-called secret of the atomic bomb. This would show other nations that we have no intention of using it. In view of the head start we have, in view of the time which would be required for other nations to produce atomic bombs even if they knew all that we knew about them today, the period

(Continued on page 126)

[2] Ibid.

Fig. 5. The tiled fireplace is all that remains to mark a spot in Hiroshima where a house once stood. Beyond in complete ruin, result of the force of the atomic bomb. Acme Photo

Spraying of Gear Lubricants[1]

Two methods of application described—Spraying permits wider choice of lubricants—Advantages of spraying lubricants listed—Additives used for fortifying gear lubricants for use on bronze and babbit-to-steel

By D. E. WHITEHEAD[2]

UNTIL a few years ago, the application of lubricants to gears by spraying was confined to fluid oils. It is now possible to spray extremely plastic greases. In general, lubrication of enclosed gears has been better engineered, through a greater selection of better adapted methods, than is the case in open gear types.

There are two general types of spray delivery. The earliest development, and probably the most popular, closely duplicates the conventional spray gun, utilizing air for priming the grease to the spray nozzle and also for the propelling or delivery air blast. Quite viscous greases are delivered to the gears in fully controlled spray patterns. The second method embodies the delivery of a liquefied stream of grease forced by air actuated mechanical pressure through a controlled orifice located in the spray nozzle. Some compromise, however, is usually necessary in either of these methods of spray gun application.

The limitations in flexibility ascribed to the various types of grease spray guns will restrict their general use for open gear application. The necessity of providing air outlets and the rigging, handling, loading, and storing of the spray guns causes some deliberation attending their use.

Most of the lubricants developed for use in the grease spray gun are of the extreme pressure type. This means an advantage of approximately five to seven times the protection provided by a non-additive type lubricant in load carrying capacity. The advantages of this type of lubricant are many, dependent to some extent upon the nature of the additives employed. Among the advantages gained through the utilization of spray application and spray lubricants as compared to the common practice of applying residual petroleum lubricants (gearshield) to gears by swabbing or pouring are:

1. HIGH ANTI-WELD VALUE. Enduring anti-weld qualities are difficult to attain in spray applications. The long interval between lubricant replenishment coupled with the diminishing film requires unusual quality of fortification in the lubricant additive.

2. HIGH FILM STRENGTH, LUBRICITY, OR OILINESS VALUE. These factors would vary according to the composition of the additives employed in a specific lubricant though, generally, most of all these values and their respective benefits will be found in the leading spray gun lubricants.

3. GOOD METAL WETTING ABILITY. Spray gun lubricants have been developed for maximum metal adhesieness under high rubbing pressures. Wetting ability and metal adhesiveness are closely associated in effecting good thin film lubrication.

4. FULL PROTECTIVE VALUE WITHOUT EXCESSIVE COVERAGE. Since the use of extreme pressure lubricants, incorporating chemically active thin film lubrication, precludes the necessity of the functioning of a fluid or hydrodynamic film, excess lubricant is useless. It is initially difficult to accustom mill lubrication personnel to thin film operation, but practice and observation rapidly satisfies any apprehension.

5. LESS RETENTION OF CONTAMINANTS UPON TOOTH SURFACES. Heavy petroleum residuals or similar materials function as binders and imbed abrasive materials that are reworked on the tooth surfaces, to their damage. Thin film lubrication holds a decided advantage in this regard.

6. UNIFORM OPERATING CHARACTERISTICS INDEPENDENT OF ATMOSPHERIC TEMPERATURE. The thin film operating characteristics of the spray gun lubricants render the film almost impervious to atmospheric temperature consistency problems.

7. REDUCED POWER CONSUMPTION. Under some conditions, operation of a unit lubricated with a petroleum residual is almost impossible until expensive temperature corrective measures have been taken. Such conditions do not exist when thin film lubrication is utilized.

8. LESS FREQUENT APPLICATION OF LUBRICANT. There is no advantage gained by maintaining a heavy or dense application of the spray gun lubricant upon gear surfaces. The thin coating will survive for surprisingly long intervals. Reports of actual tests show maintenance intervals from four to twenty times as long as equal protection afforded by residual petroleum lubricants. While initial cost of spray gun greases is somewhat higher than for residual materials, the less frequent applications necessary permit a lower lubrication cost on the part of the spray gun greases, labor being a large factor.

Spraying may be augmented by other methods of applying lubricants that have been developed primarily for the spray gun. Grease spray guns are generally thought of as a portable method of applying lubri-

(Continued on page 92)

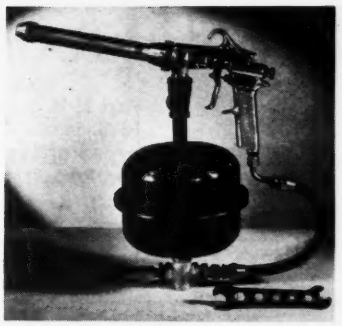

Fig. 1. Portable lubricant spray developed by Hodson Corp.

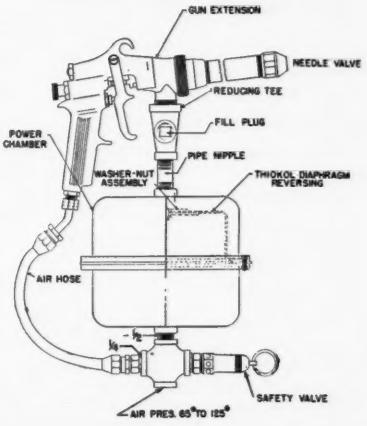

Fig. 2. Diagram and part section of Hodson-DeVilbiss power grease spray. Grease reservoir is filled with lubricant through plug opening by means of a grease gun. This forces the thiocol (synthetic rubber) diaphragm to the bottom of reservoir. With filling plug closed compressed air at 75 to 125 psi is admitted beneath diaphragm in the reservoir through pipe fitting at the bottom. Air is carried through a hose and the gun handle to a trigger operated valve which controls air pressure to a spray nozzle. Further depression of the trigger open a needle valve admitting grease into the air spray, the grease being forced out of the reservoir by the air pressure under the diaphragm.

[1]Condensation of paper presented before Annual Meeting of the Pittsburgh Section, American Association of Iron and Steel Engineers, and Philadelphia Section on September 26 and October 6.

[2]Lubrication Engineer, Carnegie-Illinois Steel Corp., United States Steel Corp. Subsidiary, Pittsburgh, Pa.

Continuous Blowoff for Boiler Plants

Part II is a continuation of a two part article started in the February, 1946, issue—The flash principle and its advantages are described—Types of systems now in use and available to industry—Features of application—Pointers on selection of heat exchanger equipment

By Herman G. Ebert and Joseph Thompson **Sales Engineers, Cochrane Corp.**

ADVANTAGES of continuous blowoff can be most economically attained through the use of equipment employing the "flash" principle. With this method of operation, the concentrated boiler water is introduced into a tank operating at any desired pressure lower than the boiler pressure, although usually this pressure corresponds to that of the operating pressure of the feedwater heater in the simplest single stage system. Because the blowdown water is at a temperature corresponding to the pressure at which the boilers are operating, a reduction in the pressure causes "flashing" and steam is generated at the lower pressure. This steam can be utilized to heat feedwater in an open or deaerating heater or can be condensed in a closed heater or flash condenser, imparting heat to the water at a point beyond the deaerating heater. This unflashed water is generally passed through a heat exchanger, the cooling medium being the makeup water on its way to the boiler.

The advantages of such a system are:

(a) The steam resulting in flashing is returned to the feedwater as condensate. In a well designed flash tank, providing controlled steam and water velocities and incorporating sufficient volume for proper separation of steam from water, the condensate is of high quality, free of carryover. The return of this water to the feedwater cycle decreases the quantity of makeup to be treated, as has previously been illustrated.

(b) The heat exchanger is smaller because it handles only about 50 per cent of the total heat available in the blowoff water.

(c) The heat exchanger operates under low pressure, giving greater assurance against leaks, tube failures, etc.

(d) With a multiplicity of boilers, only one flash tank and one heat exchanger is required, greatly simplifying the equipment and its installation. Furthermore, because the waste water is introduced into the heat exchanger at low pressure and from a single source, the flash tank, flashing in the exchanger and steam "hammer" is avoided.

(e) The combination of flash tank and low pressure heat exchanger can be provided at lower cost of equipment and installation than a system involving a high pressure heat exchanger only.

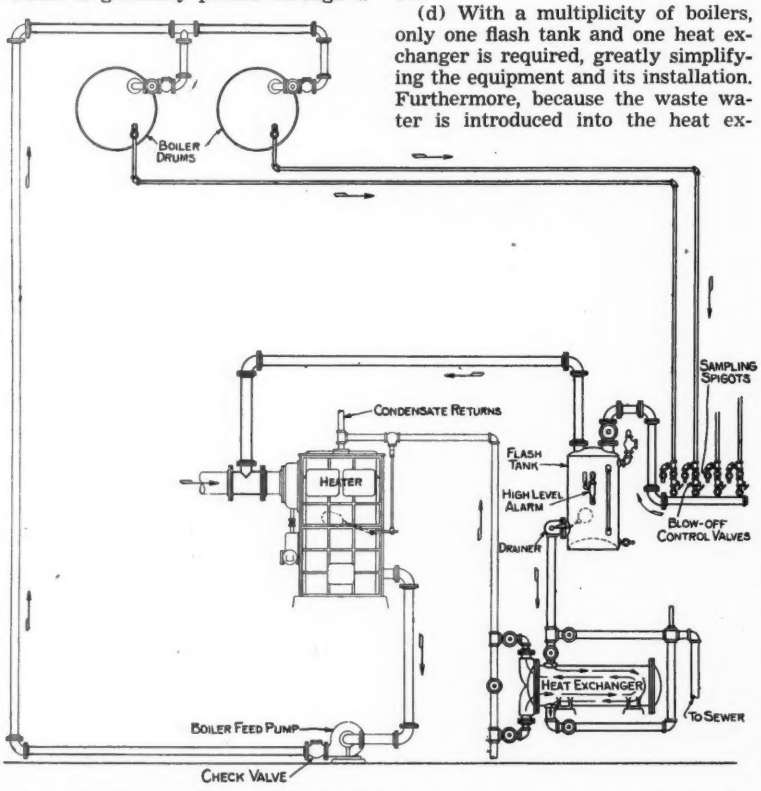

Fig. 5. Continuous blowoff equipment diagram of connections for condensing flashed steam in open heater

Types of Systems Available and Their Application

Figure 5 illustrates a simple and efficient continuous blowoff system for use in plants where additional low pressure steam can be used. This arrangement is applicable to the majority of steam plants, and takes full advantage of the flash principle and all of the heat and water economies made possible by continuous blowoff. It may be used with or without the heat exchanger.

Figure 6 illustrates a continuous blowoff system for use where the supply of low pressure steam from other sources is equal to, or exceeds, the requirements for space heating, process and feedwater heating. With this system, steam is flashed at a pressure above the operating pressure of the feedwater heater and the heat of the flashed steam is used to heat the feedwater above the temperature at which it leaves the feedwater heater. This is accomplished by means of a flash condenser or closed heater designed for the proper pressures. Unlike the system using a high pressure heat exchanger alone, the shell of the flash condenser need not be designed to withstand the boiler pressure, but needs only to withstand the design pressure of the flash tank, which is always considerably less than the boiler pressure. This system has the further advantage of water economy over a high pressure heat exchanger used above, in that the condensed flash steam is recovered as condensate quality feedwater. The low pressure heat exchanger will generally not be required, but may be used if circumstances warrant it.

The system illustrated in Fig. 7 utilizes flash steam at two or more pressures, by means of multiple flash tanks. With this arrangement practically all of the heat in the blowdown is recovered and utilized at three or more levels according to the plant requirements. Such a system in-

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creases the utility of continuous blowdown without losing any of the advantages.

Another possible continuous blowdown arrangement is the use of a high pressure heat exchanger directly in the blowdown line. This system is nearly equal to the foregoing arrangements insofar as heat recovery and maintenance of proper boiler concentrations is concerned, but has a number of disadvantages. No water recovery is effected. The heat exchanger must be designed for boiler pressures and is, therefore, expensive. Flashing may occur in the exchanger causing erosion and subsequent difficulties. All the disadvantages of handling high pressures are encountered. Control of blowdown from individual boilers is more difficult due to high and sometimes variable back pressure in the heat exchanger often necessitating the use of separate or divided heat exchangers.

It is interesting to note at this point, that the design of continuous blowdown equipment is quite flexible and can be varied to suit almost every plant requirement. As an example of this, Fig. 8 illustrates a system now in successful operation in the large mid-western chemical plant of the Dow Chemical Co. Here, a 1400 psig boiler is blown down continuously to a 400 psig boiler which serves the double purpose of boiler and high pressure flash tank. The flash steam from the high pressure blowdown becomes a part of the steam generated in the 400 psig boiler. A considerable water saving is effected at this point since the lower pressure boiler can operate at a higher solids concentration than the 1400 psig unit, and it is, therefore, necessary to blow from the 400 psig boiler only a part of the water received from the 1400 psig unit. The total blowdown from the 400 psig boiler now passes to a flash tank furnishing flash steam at 150 psig pressure, after which the remaining water passes to a 10 psig flash tank furnishing low pressure steam. The residue is then passed through a heat exchanger to waste. This system takes advantage of all of the possible benefits of efficient continuous blowdown, and, although somewhat more costly than most systems, its heat, water and operation economies make it an excellent investment.

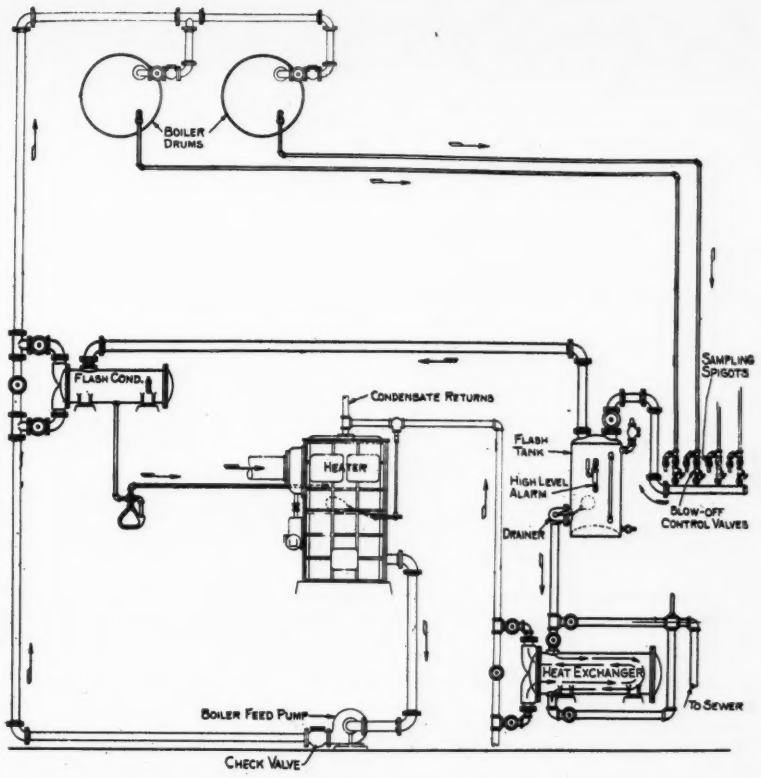

Fig. 6. Diagram of connections for continuous blowoff equipment arranged for condensing flashed steam in a high pressure closed heater

Selecting the Equipment

In selecting equipment for a continuous blowoff system, it is highly desirable to choose that which offers the best engineering design and construction, as well as rational guarantees of results to be obtained.

The most important feature of a flash tank is its ability to deliver flash steam of good quality. The tank should be, in effect, an efficient steam purifier or separator, since it receives steam carrying 80 to 90 per cent of moisture and should deliver steam of very good quality. Manufacturers of properly engineered flash tanks containing practical and efficient moisture separating means, will give definite guarantees covering moisture content of the flashed steam. In standard designs the moisture should not exceed 1 percent while special designs can reduce this to ½ of 1 per cent.

Flash tank accessories should include a suitable relief valve, gage glass, high water level alarm switch and a drainage control of a design that is consistent with the operating pressure of the tank.

Considerable thought should be given to the selection of heat exchange equipment. For instance, it is possible to buy a heat exchanger which will cool the blowdown water to within a degree or two of the temperature of the cooling water. Such a heat exchanger would be very large in comparison to, and considerably more expensive than, one which would cool the blowdown to within 15 or 20 F of the cooling water temperature.

Yet the smaller heat exchanger operating in a well designed continuous system will, in practically all cases, complete the recovery of better than 95 per cent of the heat of the blowdown. Therefore, the additional investment of the oversized heat exchanger can be paid for only by the recovery of a portion of the 5 per cent available for recovery. In a case where the annual savings amount to $1500 per year from recovery of 95 per cent of the heat of blowdown the recovery of 3 or 4 per cent more through an extra large and more costly heat exchanger would result in a saving of but $45 to $60 per year. In general, therefore, it can be said that the most economical terminal difference for continuous blowoff heat exchangers will be in the order of 15 to 20 F.

Well designed heat exchangers for blowdown service are usually of the U-tube type with the cooling water passing through the tubes and the blowdown outside the tubes. Connections and baffles are arranged according to the counterflow principle. U-tubes are preferable to straight tubes in that they prevent the setting up of thermal stresses and the consequent loosening or breaking of tubes. Their construction is simpler and less expensive. The problem of cleaning U-tubes is easily taken care of by flushing them with a 10 per cent solution of inhibited muriatic acid. Brushing or mechanical cleaning is rarely necessary.

Passing the cooling water through the tubes of a blowdown heat exchanger is desirable since it allows the exact calculation of the velocity of the cooling water, and permits the coefficient of heat transfer to be predicted more accurately than with the opposite arrangement, since the transfer rate is more critical to the cool side than to the hot. Furthermore, the hard deposits sometimes formed

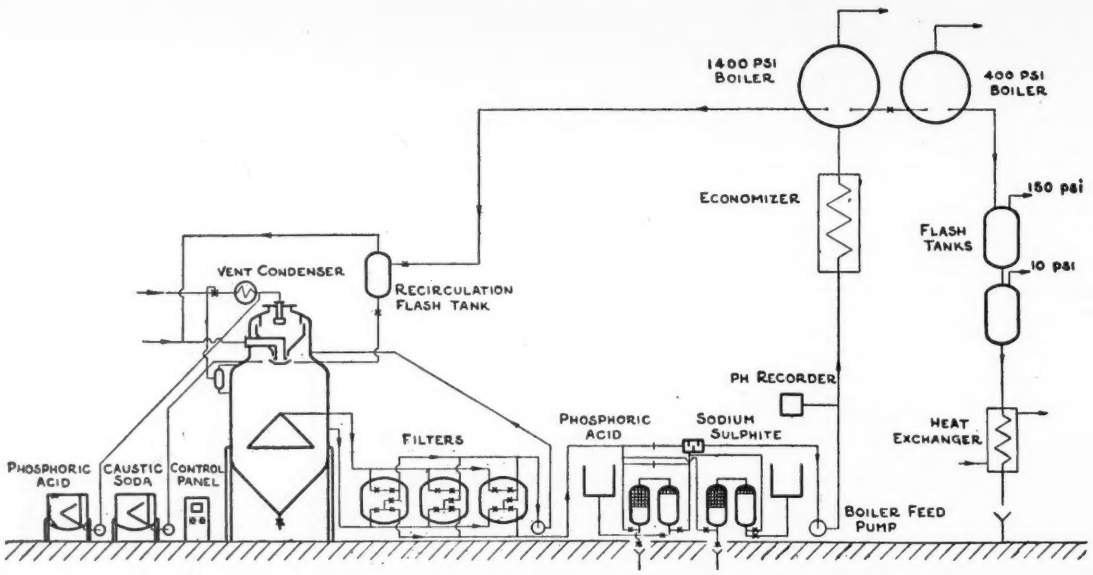

Fig. 8. Flow diagram of water conditioning equipment showing deaerating hot process softener, with boiler water recirculation to softener sedimentation tank for conservation of phosphate, chemical feeds, filters, phosphoric acid and sulphite feeds and unusual three stage flash system of continuous blowoff

on the cooling water side of a heat exchanger are more readily removed from the inside of the tubes than from the outside of the closely packed tube bundle.

For controlling the blowoff, a V-port valve designed for this service and equipped with a graduated dial has proven to be most satisfactory. One valve is required for each boiler.

A blowoff sample cooler and test apparatus for testing the blowoff concentrations should also be included in the system.

Hundreds of systems, of the types described, are in successful operation in plants throughout the country. For those plants not so equipped, a study of the possibilities of a continuous blowoff system adapted to the particular conditions is in order on both economic and operational grounds.

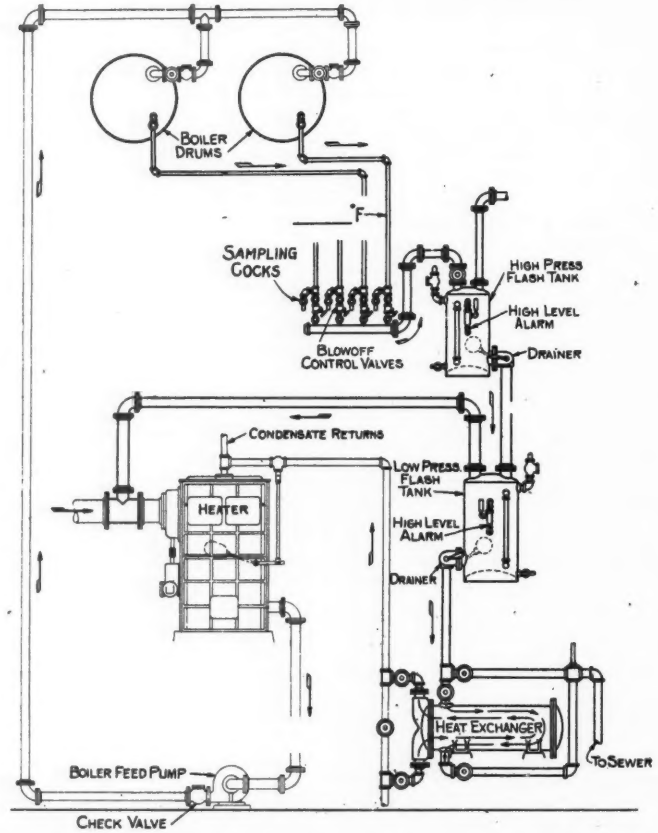

Fig. 7. Diagram of connections of continuous blowoff system for utilizing flash steam at two or more pressures

Spraying of Gear Lubricants

(Continued from page 89)

cants. It would, however, appear reasonable that small units having adequate grease capacity could be permanently affixed to certain critical gear trains, the spray being interrupted by a time clock designed for the purpose.

Definite correlation has been found between test block temperature, measurable test block wear and the various additives used for fortifying gear lubricants. These additives, which included lead (naphthanate and oleate), sulphur, (in combined forms), chlorine, phosphorus, paratac, latex, and mica alone and in combination, were known to have value in steel-to-steel application of lubricant and were studied to verify their application in bronze and/or babbit-to-steel.

The higher melting points (ASTM Dropping Point), higher load carrying values and smooth texture, combined with good metal adhesiveness characteristics, ideally suits the spray gun lubricant for almost any moderate or slow speed bronze or babbit-to-steel bearing application. Where water conditions, extreme temperature or speeds are encountered, other lubricants may be better qualified.

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

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Vars Are Cheap These Days

The average price of capacitors for generating kvars near the load is less than one-quarter of the 1930 price, according to a recent report by the General Electric Co. Also, the margins of transmission-line and generator capacity that were normally available ten or more years ago, to supply increased loads, are now very much reduced, in consequence of economic pressures and scientific design. These two factors combine to make the strategic installation of capacitors, at points where they can do most good in cutting down conductor currents and improving voltage regulation, a major opportunity for economies in the post-war period immediately ahead.

It is not uncommon to find that about one third of the kvars supplied by the generators in power stations are lost before they reach the pay load, because of increased reactance voltages consequent on the extra current. Thus capacitors applied at the load need only have about two-thirds of the kvar capacity that would be required in the generator. To meet this situation the operator must have full control of the sources and paths of the flow of vars, throughout the power system.

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A Section of Power Plant Engineering Devoted to PLANT OPERATION AND MAINTENANCE

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The Function of the Evaporator in Practical Refrigeration*

By George Holman

The importance of the evaporator . . . Its simplicity . . . Heat transfer, in theory and in practice . . . Desirable qualities in an evaporator . . . Rules of thumb for estimating or checking refrigeration equipment

THE EVAPORATOR has the appearance of being one of the simplest pieces of equipment in a refrigeration system. In many instances it is only a group of parallel pipes made to form a continuous hollow circuit by U-bend connections at the ends. In other instances it is a cylindrical vessel through which numerous tubes run longitudinally. Even in its most complex design it is only a mass of tubes or pipes, with or without fins, enclosed in a case with a fan or blower. It is so simple that the poorest mechanic or pipefitter can make one.

Yet the evaporator is not only one of the four most important pieces of equipment in the refrigerant circuit; it is the only absolutely indispensable piece of equipment, excepting only the refrigerant itself. It is the one piece of equipment which can operate alone, and for which there can be no substitution.

An analysis of just any refrigeration system will show why this is so. For example, suppose that an unlimited source of liquid ammonia, or other liquid refrigerant, should be found in nature, or that a very cheap method of making it could be invented. Such liquid refrigerant could then be shipped in pressure cylinders to ice plants, cold stores, etc., just as they are done when charging existing refrigeration systems today. The cylinders could be set inside the compartments or brine tanks to be cooled, and the valves opened. The small amount of vapor under pressure in the cylinders would escape, and the liquid would begin to boil at the lower pressure. The temperature of the liquid would fall, and it would begin to absorb heat from its warmer surroundings. Each cylinder would become an evaporator and cool the space and objects about it.

Should such a cheap and unlimited supply of liquid refrigerant become available, much standard refrigeration equipment could well be scrapped. Only the evaporative system—expansion valve, evaporator and return line, or vent—would remain. In many instances the regulatory office of the expansion valve would not be needed. And unless the vapor of the refrigerant were obnoxious or otherwise undesirable in the cooled compartment, the return line for carrying away the vapor might also be dispensed with.

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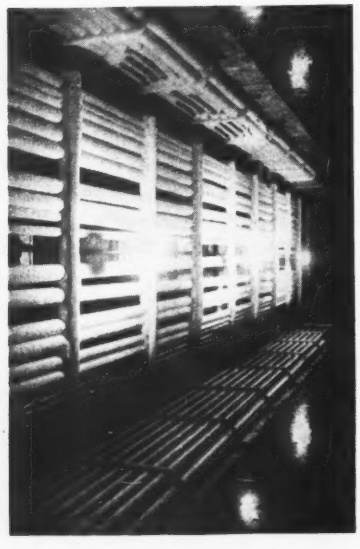


Fig. 1. Typical direct expansion evaporators exposed to heat transfer by radiation from the load. Due to accumulations of frost, the white color of which reflects radiant energy, the absorption of heat by the evaporator by this method is none too successful

Theoretical and Practical Aspects of Heat Transfer

The most practical known method of transferring heat from one fluid to another is to pass them over opposite sides of a thin metal wall. Regardless of how much heat each of the fluids contains, or in what form it is, heat will flow from the one having the higher temperature to the one having the lower temperature. To keep up a continuous heat exchange, it is necessary to circulate one or both of the fluids by mechanical means. Thus an original cold fluid which has absorbed heat through the metal wall must be moved away, and a fresh supply of the same cold fluid brought into contact with it. Likewise, the warm fluid which has been cooled must be removed by gravity or mechanical circulation, and a fresh supply of warm fluid brought into contact with the metal wall. In general, the more rapid the two fluids are circulated over the metal surface, the quicker the warm fluid will be cooled and the cool fluid warmed.

Other factors influence heat transfer, however. Thickness of the wall is one factor directly affecting heat exchange. The material of which the wall is made is another. The internal thermal conductivity of metals varies widely. In round numbers, one square foot of a copper wall one inch thick will permit 2,000 Btu per hour per degree difference in temperature to pass through it; aluminum will permit but 1,000 Btu per hour per degree to pass through a one-inch thick wall, while steel will permit but 500 Btu to pass. To reduce these values to wall thicknesses of 1/8 in. and 1/16 in. found in practice, multiply them by 8 and 16 respectively.

It will be found in practice that no steel tube of ⅛ in. wall thickness will pass 500 × 8, or 4,000 Btu per hour per degree difference in temperature. This is because much of the resistance to heat transfer is to be found in the condition, texture, and even color of the wall, to the physical state of the two fluids exchanging their heat, to the presence of foreign substances on the walls, and so on.

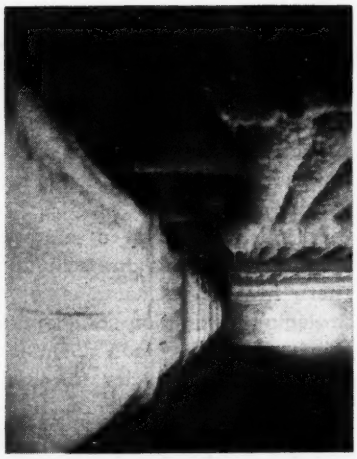


Fig. 2. Frost heavy enough to close the spaces between the pipes stops air circulation, and therefore checks evaporation. Such an accumulation of frost on evaporators is accompanied by a gradual drop in suction pressure, reduction in superheat at the return valves, warming up of the coolers and increased running time of the compressors

Characteristics of a Good Evaporator

An evaporator for a liquid refrigerant must possess a number of qualities. It must present enough surface in a wall that is thin enough to pass the heat without excessive resistance, yet be strong enough to hold the refrigerant under pressure. The walls must be clean, yet not subject to chemical attack or corrosion by the refrigerant. It must permit circulation of the refrigerant and of the fluid to be cooled. And it must be properly located.

In some designs of evaporators, some heat reaches the external sur-

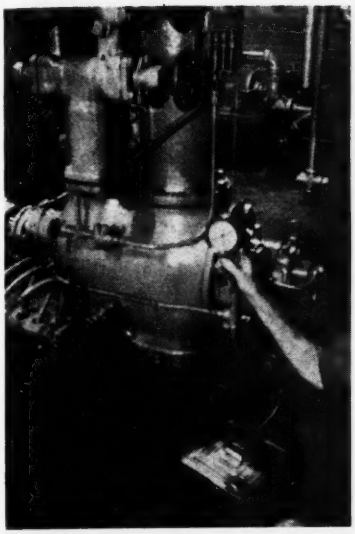


Fig. 3. All oil put into the compressors should be measured and accounted for by an equal amount of refuse oil blown out of the various oil traps of the system

face of the pipes by radiation (Fig. 1) directly from the goods to be cooled. Such evaporators can be used only where the secondary fluid is air, and where they are continuously below frost temperature (32 F). Otherwise, melting of the frost from the pipes would damage goods in storage. An evaporator used for cooling brine cannot, of course, be exposed to heat absorption by radiation.

In most evaporators, however, the quantity of heat reaching the transfer surface by direct radiation is small. Most of it is brought to the evaporator by that form of heat movement called convection, or carrying by the secondary fluid. In ice making and other indirect expansion systems, the secondary fluid is brine. In so-called direct expansion systems the secondary fluid is air. In practice, convection is nothing more than pumping, blowing, or otherwise circulating, or permitting to circulate, the heat laden fluid over the heat transfer surface.

A piece of 1¼ in. pipe 3 ft long exposes approximately 1 sq-ft of heat transfer surface. If this unit of heat transfer surface is on a direct expansion evaporator heavily covered with frost, as in Fig. 2, and dependent upon natural circulation of air to bring heat to it, it may possibly absorb 1 Btu per hour per degree difference in temperature between the air and a mixture of ammonia liquid and ammonia vapor in turbulent circulation in the evaporator. Transfer of this 1 Btu per hour per degree per square foot would be from air cooling to liquid boiling at constant temperature, and with air circulating at approximately 100 ft per minute.

Due to its white color, frost reflects and does not permit radiant heat to be readily absorbed by the evaporator. Frost also has a pronounced insulating effect. If the heavy coating shown in Fig. 2, which has become thick enough to prevent air circulation between the pipes, were removed so that dark, rough pipe surface would be exposed to the air, heat would be transferred much more readily. The increase would be due to removal of the insulating effect of the frost, to the change in color to permit more heat absorption by radiation and to the more rapid circulation of air brought about by increased cooling effect of the first two factors. Every operator of a direct expansion system is aware of the rapidity with which a freshly defrosted evaporator can lower the temperature of the cooler in which it is located.

In the above instance it must not be assumed that each 3 ft length of 1¼ in. pipe absorbs the same quantity of heat simply because it has the same amount of transfer surface. A 3 ft length of pipe near the expansion valve of some evaporators may absorb a hundred times as much heat as the same unit length near the return pipe. This is especially likely to be the case where an evaporator is not worked at capacity, and the vapor leaving the evaporator is at a much higher temperature than that indicated on the suction pressure gage.

Whether an evaporator receives its heat by conduction from a solid, as in rare installations, by direct radiation, from the air, or from brine or other fluid, the rate of heat arrival may be assumed to be constant over any short period of time. If the secondary fluid moves at right angles to the flow of the refrigerant, the same quantity of heat probably reaches one unit of transfer surface as another. Any rapid variation in the rate of evaporation therefore must be attributed to the refrigerant, its pressure, rate of flow, etc.

Rules of Thumb

At pressures of 15 psi suction and 150 psi discharge approximately 4 cu ft of saturated ammonia vapor must be pumped per minute to produce 1 ton of refrigeration in 24 hours. Should the suction pressure fall to 10 psi, while the discharge pressure remained at 150 psi, approximately 4.75 cu ft of vapor would have to be pumped to produce 1 ton of refrigeration. At 20 psi 3.33 cu ft would be pumped per ton, while at 25 psi only 3 cu ft would be necessary.

These round figures are rules of thumb which the operator should remember, as they are useful in estimating or checking the performance

"What's my telephone number?—Valentine 1313, and what's yours?"

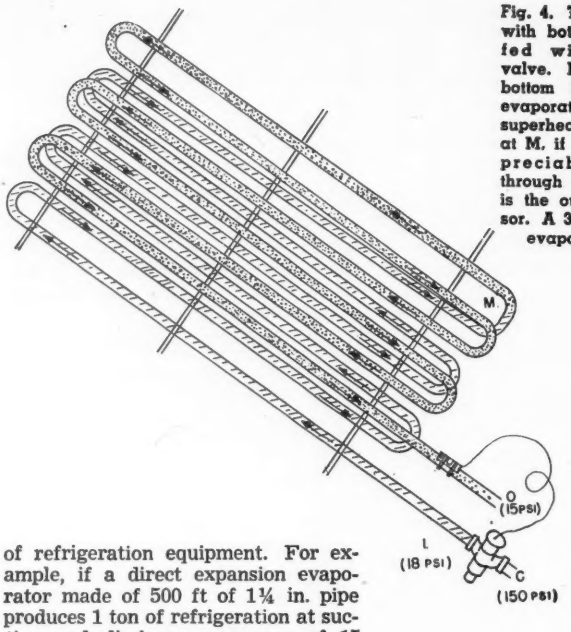


Fig. 4. Two-level evaporator, with bottom inlet, top outlet, fed with thermoexpansion valve. In normal operation bottom layer of pipes are evaporating, top (dotted) for superheating. Coldest point is at M, if pressure drop is appreciable. I is the inlet through the thermal valve, O is the outlet to the compressor. A 3 psi drop through the evaporator is assumed

of refrigeration equipment. For example, if a direct expansion evaporator made of 500 ft of 1¼ in. pipe produces 1 ton of refrigeration at suction and discharge pressures of 15 psi and 150 psi gage, respectively, 4 cu ft of vapor must leave the evaporator each minute. This is 4 × 1728, or 6,912 cu in. per minute. Since pipe 1¼ in. in diameter contains a volume of 1 cu in. per linear inch, the vapor must leave the last evaporator pipe at the rate of 6,912 in. per minute. Dividing 6,912 by 12 equals 576 ft per minute, or 9.6 ft per second.

If the vapor leaving the evaporator is superheated, that is, at a temperature higher than that indicated by the suction gage, the velocity will be greater. The figures calculated pertain to the final velocity of the saturated vapor, not the average velocity. The flow of vapor begins with an initial velocity at the expansion valve and increases more or less steadily as evaporation adds to the quantity of vapor flowing in the continuous hollow circuit of uniform diameter.

The initial velocity of the refrigerant entering the evaporator at the expansion valve is zero only when the liquid entering the expansion valve has been subcooled to the temperature of the liquid leaving the expansion valve. If the liquid upstream from the valve is above the temperature of the liquid after it has expanded through the valve, some of the liquid will absorb heat and flash into vapor as it passes through the valve orifice. This gives the refrigerant an initial velocity directly proportional to the final velocity of the saturated vapor leaving the evaporator.

This initial velocity can be determined from the tables of the properties of ammonia as follows:

Heat of the liquid at 150 psi gage is 137 Btu.

Heat of the liquid at 15 psi gage is 42 Btu.

Difference is 95 Btu. This 95 Btu would join with a part of the liquid to form a vapor as the pressure fell through the valve orifice. This would cause an initial velocity far above zero, and determined by ratio as follows:

Latent heat of ammonia at 15 psi is 569 Btu.

Heat of the liquid forming flash evaporation is 95 Btu.

Therefore final velocity is to the initial velocity as final quantity of vapor to the initial quantity of vapor, or 576 ÷ X = 569 ÷ 95, or 576 × 95 divided by 569 equals 96. X, or initial velocity, equals 96 ft per minute.

The foregoing calculations ignore the presence of liquid, and the resistance to flow it offers. They are given to show that there is an appreciable initial velocity of the vapor having a force directly proportional to the heat of the liquid above the evaporating temperature.

Since the rate of heat absorption is proportional to the rate of flow of the fluids over the transfer surface, it may be noted that the first pipes of an evaporator do not carry the heat load it at first thought appears they should. Only in evaporators having the entire inner walls of the first pipes wetted with liquid of the refrigerant, while the last pipes are dry and superheated, is it possible for the first tubes to carry the load. If the vapor leaving the evaporator is saturated and wet, and if there is an appreciable pressure drop through the evaporator, the last pipe may absorb several times as much heat as the first, other conditions being the same across the evaporator.

Frost and Its Removal

Derived from the moisture in the air and due to air change, water on the floor, wet goods, high temperature (relative) of wet goods, breathing of workmen, low evaporator pressure, continuous operation, low cooler temperature and many other factors, frost accumulates on the pipes of most direct expansion evaporators. To maintain efficient heat absorption, it must be periodically removed.

This is done by manual scraping, by melting with water, by sprinkling with salt or a brine, or by other means. If the room is above 32 F, and if a few degrees rise in temperature is not objectionable, a simple and easy way to defrost is to cut the evaporator off and let the frost melt.

While effective, these methods of defrosting are crude and inefficient. The simplest method of removing frost from direct expansion evaporators is by use of the hot vapor of the refrigerant drawn from the condenser. The evaporator to be defrosted is pumped down, other evapo-

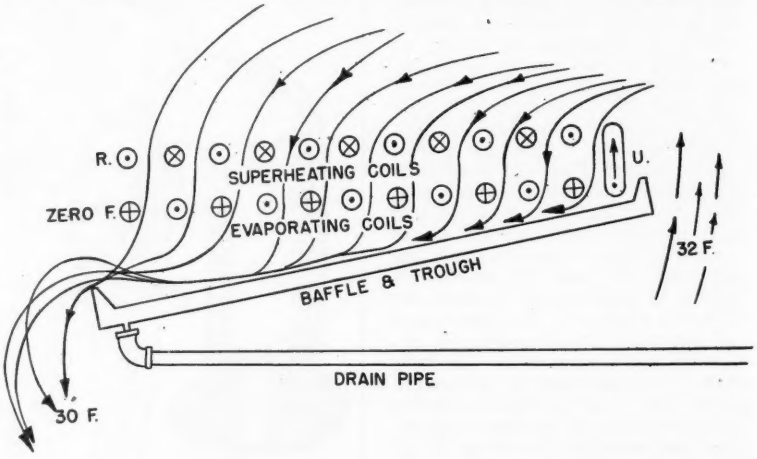


Fig. 5. Cross-section of a two-level, bottom fed direct expansion evaporator. Due to the pressure drop, coldest pipe would be last one near the riser U. At 15 psi suction pressure at E, pressure drop through length of the evaporator might reduce suction pressure at R to 11 psi. In this case, coldest pipes would be those in which evaporation was ceasing. This would also be the area of greatest velocity increase. Velocity increase would be slight in superheating coils, and be due only to expansion with temperature rise

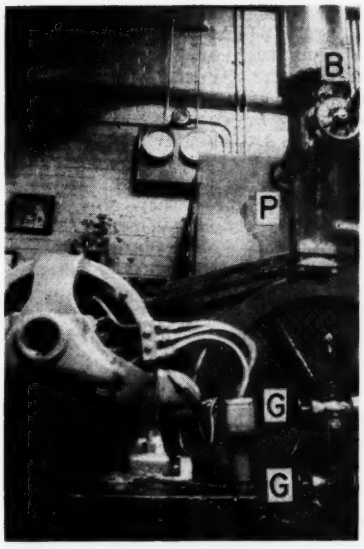


Fig. 6. When the pumpdown is complete and the condenser as warm as is safe, the compressor is stopped. Oil gage valves are closed to protect glass and seals. (G.G). Water as warm as possible (100 F) is kept running over the condenser as by-pass and pumpout valves, B and P are opened to permit hot vapor from the condenser to flow into the evaporators

rators cut off at the return valve and the quantity of water to the condenser reduced to increase the temperature, pressure and quantity of refrigerant vapor in that vessel. Opening the cooler door for a few minutes to raise the temperature of the evaporator metal and frost to 32 F is helpful in cases where the room is kept at a temperature below this point.

When the pumpdown has reached zero pressure the compressor is stopped, and pumpout and by-pass valves on the manifold immediately opened. Hot vapor flows at once back through the hot gas line and into the evaporator. If the evaporative system has recently been tested at 150 psi, suction gage pressure may be permitted to rise to 100 psi, but no further. This allows a factor of safety of 1½. After standing at this pressure ten to fifteen minutes, the frost, unless very heavy, may be easily knocked off.

ON THE AVERAGE, it costs more to distribute goods in the United States than it does to make them, according to the Twentieth Century Fund's survey *Does Distribution Cost Too Much?* Fifty-nine cents of your dollar pays for distribution, forty-one cents for production.

* * *

FIBER PEG MATERIAL made with animal glue is now used for fasteners in the manufacture of shoes. The fiber which is lighter than steel is specified by the Quartermaster Corps for governmental shoes. It is also used in safety and work shoes today.

How Shall We Manage "Safety"?

By Stanley F. Spence

This short but interesting discussion calls attention to an aspect of "safety" that is not often given serious consideration. It points out the fact that we cannot blindly follow certain rules in regard to safety and prevent accidents. Unless such rules are followed with "intelligence," unless we thoroughly understand what we are attempting to accomplish by the establishment of safety codes and safety provisions all the rules and codes in the world will not stop accidents. Mr. Spence, the author of this article is a graduate electrical engineer with practical experience in the field and with twelve years in industrial accident prevention engineering. He is, therefore, well qualified to discuss this subject.

THE TREND of industrial safety and the methods of its attainment, during the years, have been subject to the fashion of the period. Thirty years ago it began to be really understood that it should be incorporated in the design of plant layout and processes. Now, as is indicated by the tenor of most published magazine articles on "safety," it is almost entirely a matter of education.

It is the intention of this article not to disparage any of the above ways of thinking, but rather to suggest that industry's attitude toward the subject is analogous to the oldentime fable of the three blind men in their description of the elephant. The reader will recall, if he reaches back into the memories of his childhood, this simple but illustrative tale: The first blind man touched the elephant's leg and declared that the animal had the shape and surface texture of the elm tree; the second stated, upon feeling the outline of the animal's large, flapping ear, that it greatly resembled an animated fan. The third stroked the critter's tail, and proclaimed scornfully that his colleagues were entirely wrong—that the elephant was a massive snake, pure and simple. . . . And none of them realized that the poor beast was a composite of the forms which, in his restricted area, each had examined!

Have you not, in your experience, noticed actions similar to these which typify these eras?

1. The safety inspector who makes a careful note in his book to have a protruding set screw in a revolving shaft corrected, while standing alongside a boring mill operator who is straining to lift a one hundred-fifty pound casting to the bed of his machine.

2. The engineer who approves the safety features of a vapor degreaser and then ignores the fact that it is of paramount importance to have the operator carefully instructed in the proper method of using it and cleaning it.

3. The "safety engineer" who issues safety instruction cards to power press operators when half the presses are provided with improperly designed or carelessly adjusted protective devices.

Now let us see what manner of man predominates in the profession of accident prevention engineering in each of these ages, or schools of thought. It is clear, is it not? First, the pure mechanic; second, the pure engineer; third, the pure salesman. (The last sometimes terms his field of endeavor "human engineering.")

It is not suggested that there are definite lines of cleavage between the eras described, for trends do not have clear lines of demarcation.

Since there have been such divergent methods of obtaining an important result, is it not advisable now to examine that goal carefully —to study it and to clearly define it? This discussion of an aim is not rhetorical chit-chat. It is necessary spade work to discover just what we are working for. The word "safety" is generally used to designate employee well-being. But if employee well-being is the end result of all accident prevention engineering efforts, industry misses the target completely! If we so arrange our processes and conveying methods as to speed production by reducing manual handling, are we not serving employee well-being? If we make our jig and fixture designs meet the highest practical requirements of stability and ease of setup, are we not reducing the possibility of operator failure and subsequent injury to employee, tool, or material? If we thoroughly train the operator in all of the details of his job—including the why as well as the how—in order that he will be an efficient producer, are we not insuring his personal safety along with the quality and quantity of his work? How then, can we divorce employee safety from production; and why should we continue to hear of its prosecution as a distinct enterprise?

The answer to our question might rest in the fable of the three blind men. Maybe what industry needs is a balanced diet of accident prevention engineering. Maybe industry needs less "safety men" who are either pure inspectors, or pure engineers, or pure salesmen; and more good production engineers who have a thorough knowledge of the ways of combating the circumstances which result in injury to workers and materials. And maybe—just maybe—we need more Factory Managers who understand that the "safety" branch is necessary to complete the contour of the production tree, and to nourish it in its growth.

The Boiler Fireman's Handbook

By J. R. DARNELL

Factors to be considered in burning gas . . . Heat value of various gases . . . Types of burners . . . Burners for gas only . . . Combination gas and oil burners . . . Troubles encountered in burning gas

Part XIX—Gas Firing

WHEN CONSIDERING GAS firing there are several kinds of gas and numerous types of gas burners which may be available. The locality in which the gas is to be burned will to some extent, determine the type of burner, although there are several types of burners which may be used for any given analysis of gas.

Probably the most common kind of gas in use in this country is the so-called "city" gas or "manufactured" gas. Usually this is a form of enriched water gas made by passing steam over red hot coke and enriching with a light oil. Natural gas is common in many localities and in others it is mixed with "city" gas. Many industries burn producer gas, coke oven gas, blast furnace gas or oil refinery gas.

The figures in Table I show the average heat value for the above gases. Several of these gases vary over a rather wide range. For example, the heat value of natural gas may vary from 900 to almost 1200 Btu per cu ft and refinery gas from 1400 to 1600 Btu per cu ft. Coke oven gas often varies from a low of about 550 Btu per cu ft to over 1000 Btu.

Similar to the curves* shown in Part VII to determine boiler efficiency for solid and liquid fuels by reference to the CO_2—excess air relationship, Fig. 1 has been prepared to show such relationship for California natural gas firing. Fig. 2 shows not only the CO_2—excess air relationship in firing oil refinery gas but gives chimney losses for flue gas temperatures from 300 to 800 F.

Prerequisites for efficient burning of gaseous fuels are the proper type of burners, proper mixing of air and gas and sufficient combustion space. Time, temperature and turbulence are the three all-important factors in successfully burning any gaseous fuel or combinations of gaseous, liquid and pulverized solid fuels.

In localities where there appears to be an unlimited supply of a certain kind of gas—generally natural gas—the burners are designed to handle only gas, whereas in other localities where the supply of a gaseous fuel may fluctuate, combination burners are installed.

*Editor's note—After this series of articles have been completed and compiled in book form, similar curves and tables will be prepared for all of the gaseous fuels mentioned in this chapter.

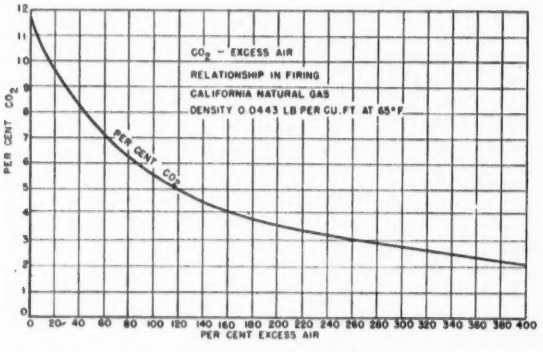

CO_2 – EXCESS AIR
RELATIONSHIP IN FIRING
CALIFORNIA NATURAL GAS
DENSITY 0.0443 LB. PER CU. FT. AT 65° F.
PER CENT CO_2
PER CENT EXCESS AIR

Fig. 1. (Above) This curve may be used to determine the per cent of excess air for any given per cent of CO_2 in the flue gas when firing California natural gas

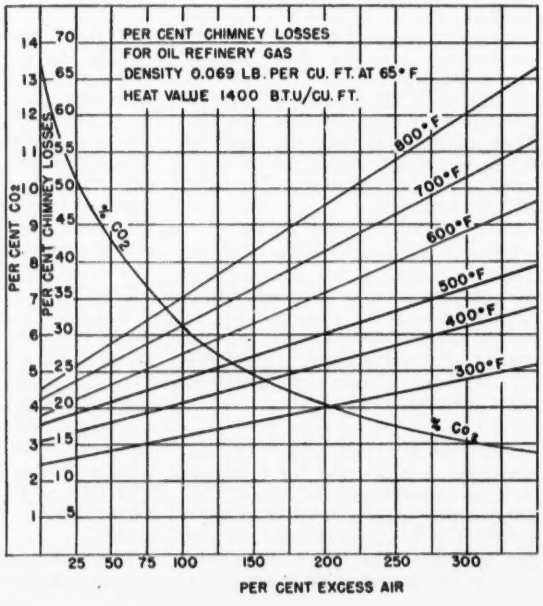


Fig. 2. (Right) Per cent chimney losses for flue gas temperatures of 300 to 800 F may be determined by this chart when firing oil refinery gas

Burners for Gas Only

Figure 3 shows a simple, though highly efficient type of burner which utilizes the jet action of the gas stream to induce or inspirate the air necessary for combustion.

In Fig. 4 the burner is designed for small boilers of square or rectangular shape. Since a minimum of head room is required they provide the maximum furnace volume obtainable. It is ideal for natural gas.

Figure 5 shows a burner designed primarily for burning high Btu refinery gas. The high turbulence obtainable is shown in the cross-sectional elevation to the right.

In Fig. 6 is shown a type of natural draft gas burner similar to Fig. 3 in which both primary and secondary air is drawn into the furnace by the jet action of the gas flow.

Burners for Gas or Oil

In certain localities where both gas and oil are available fluctuations in the price of oil may make it advantageous to burn gas for a period when the price of oil is high and then switch back to oil if oil prices drop. Figure 7 shows a type of burner in which either oil or gas may be burned by inserting the proper fuel gun. This burner may be used with either forced or natural draft, the Btu input with forced draft being about 25 per cent greater.

Table I

Heat Values of Gaseous Fuels at 65 F

Trade Name of Gas	Btu Per Lb	Btu Per Cu Ft
"City"	15,300	580
Natural	21,300	940
Oil Refinery	20,300	1,400
Anthracite Producer	1,900	134
Bituminous Producer	1,400	110
Coke Oven	14,300	580
Blast Furnace	1,200	98

Combination Burners

In certain plants where high heat input is required, manufacturers have designed numerous types of burners

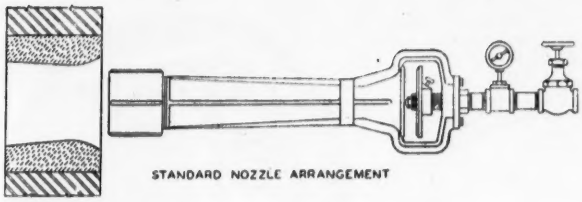


Fig. 3. This is a type of gas burner with natural draft in which the kinetic energy of the entering gas streams inspirates the air necessary for combustion

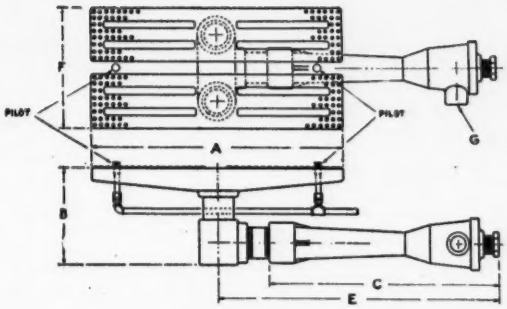


Fig. 4. Square or rectangular burners such as this one are used under small boilers to give the maximum furnace volume obtainable

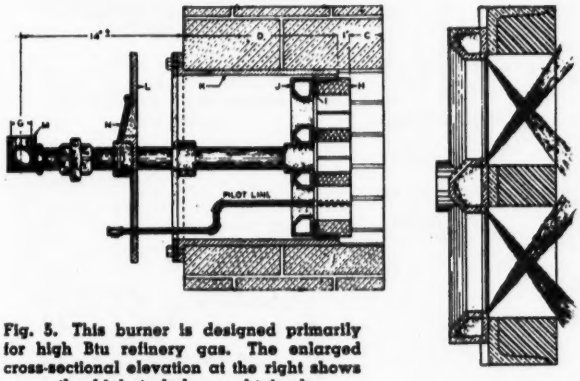


Fig. 5. This burner is designed primarily for high Btu refinery gas. The enlarged cross-sectional elevation at the right shows the high turbulence obtained

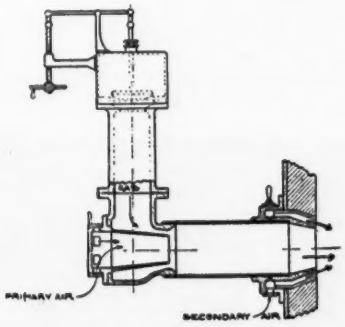


Fig. 6. This is another type of gas burner in which the air for combustion is drawn into the furnace by the inspirating action of the gas flow. This burner provides for both primary and secondary air

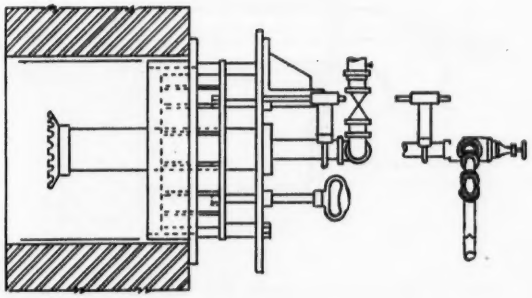
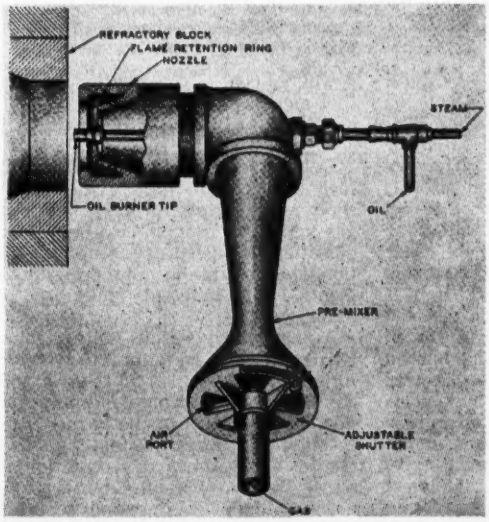


Fig. 7. Where either oil or gas may be desirable this burner may be used by inserting the proper fuel gun



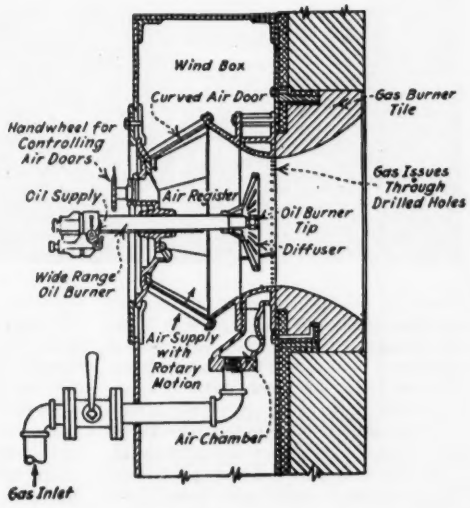


Fig. 8. (Left) This is a combination oil and gas burner for natural draft with the air and gas premixed before firing

Fig. 9. (Above) This combination burner for gas and oil is designed for forced draft and delivers 30,000 cu ft of gas per hour at 3 lb pressure

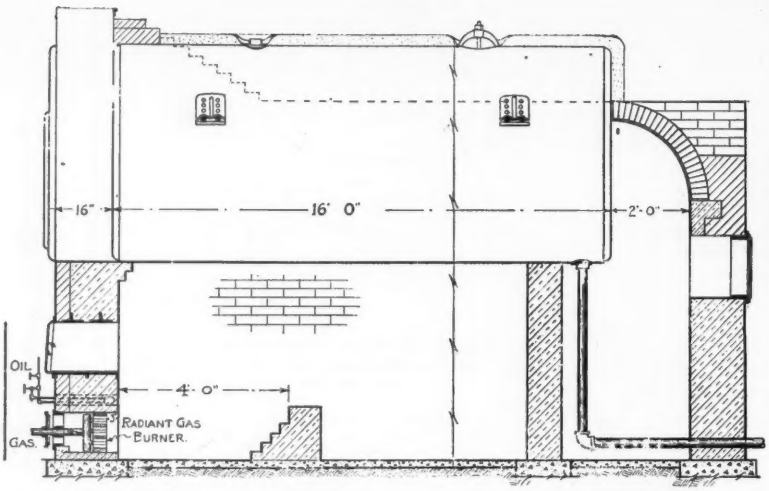


Fig. 10. This HRT boiler is fired with low pressure gas burners or a combination of oil and gas. For low loads, oil only may be used

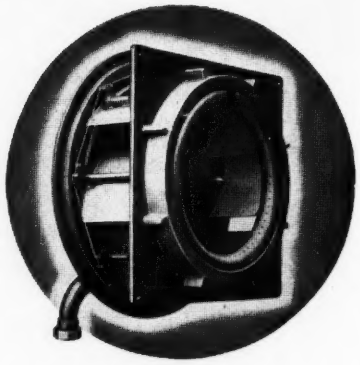
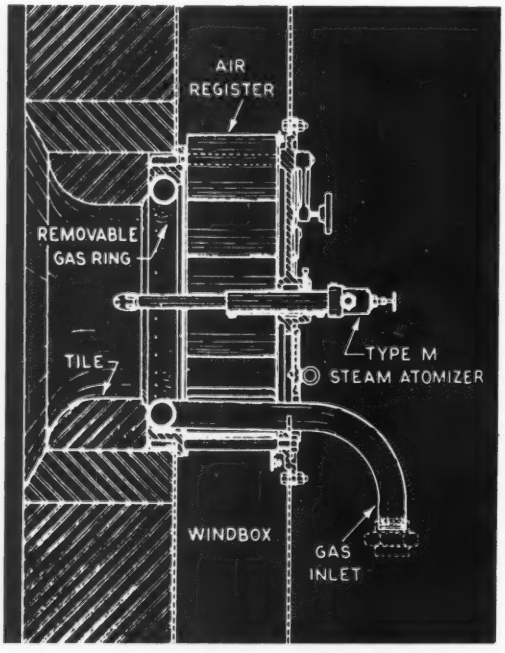


Fig. 12. A perspective view of the gas ring and air shutters of the burner in Fig. 11 is shown here



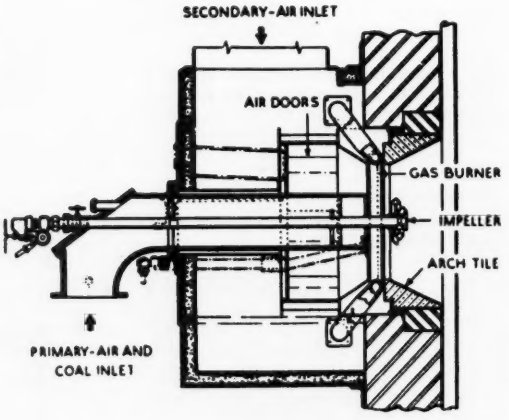


Fig. 11. (Left) Here is a heavy duty combination gas and oil burner firing both fuels simultaneously or singly

Fig. 13. (Above) This is one of the latest combination burners for gas, oil and powdered coal either singly, with two fuels or all three simultaneously

in which oil and gas may be burned simultaneously. There are also types of burners which permit the firing of powdered coal along with oil and gas. Certain types of these burners operate with natural draft while others for even higher heat input, use forced draft which also may be preheated.

In Fig. 8 is shown a type of burner using natural draft and firing premixed air and gas. The oil burner is of the steam atomizing, internal mixing type.

In contrast to the burner of Fig. 8, Fig. 9 shows a burner using oil and gas with forced draft. It delivers 30,000 cu ft of gas per hour at 3 lb pressure.

Figure 10 shows a cross-sectional side elevation of an HRT boiler and furnace provided with oil and gas burners, the latter being of the multi jet type and designed to operate on low pressure gas. Each burner comprises a cast iron box upon the inner face of which are cemented refractory material with X shaped openings. This refractory material soon becomes red hot and accelerates combustion to such an extent that a short clear flame is produced without resorting to an auxiliary checker wall.

A heavy duty combination gas and oil burner is shown in Fig. 11 in which either oil or gas may be burned alone or simultaneously. Gas is fired through a removable ring with ports as shown in Fig. 12. The oil burner is centered in the ring and is of the steam atomizing inside mixing type.

Figure 13 illustrates one of the latest types of burners for firing gas, oil and powdered coal in combination or each fuel alone.

Troubles Which May Be Encountered in Gas Firing

Delayed combustion and resultant long smoky flames or localized hot spots are due to improper mixing of gas and air. Sometimes there are pulsations in the furnace. Such conditions may be due to improper adjustments or to inherent faults in the design.

A particularly serious fault in some burner designs is failure to provide for greater velocities of the air and gas than the speed of flame propagation. A flash back of the burner may result if the burner is faulty in this respect. Sometimes this condition is so aggravated that the burner will not stay lighted. As previously stated

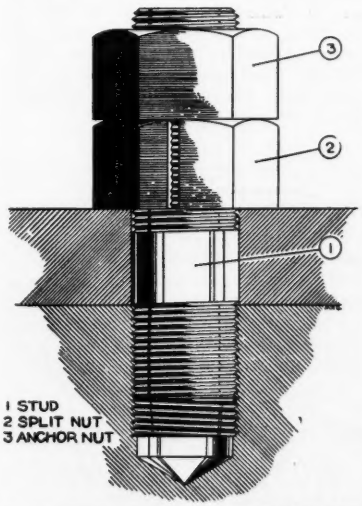
the three all-important factors are time, turbulence and temperature in effecting proper ignition in the furnace after the gas and air have passed through the burner. Of course, less turbulence in the furnace is required, in most cases, if the air and gas can be premixed prior to entering the furnace. Since the speed of flame propagation with commercial gaseous fuels is low, the fireman ordinarily need not worry about this phase of the burner design. He must be sure that the burner is clean, that spare parts are readily available at all times and that there are no valves left open to admit unburned gas to the furnace.

If a gas burner (also applies to oil or powdered coal), shut off the supply valve and open the damper before attempting to relight the burner. A firing torch should always be available.

PRACTICAL HINTS AND KINKS

Stud Removing Simplified

A SELF-LOCKING jam nut is used at General Electric's Erie Works to remove studs without damaging the threads.



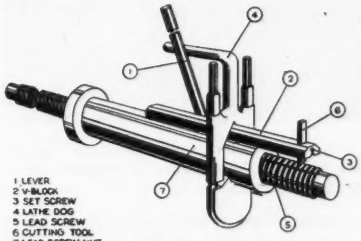
Sketch showing use of the self-locking jam nut

Two standard nuts — one slotted lengthwise—are backed against each other. The pressure of a wrench on the split nut binds it to the stud threads, providing extra friction by which the stud may be removed. The second nut is used as an anchor.

Repairing Machine Lead Screws

A QUICK and easy method of reconditioning damaged threads on lead screws, deformed either by accident or normal wear, has been devised by Clifton Roberson, a maintenance man at General Electric's Erie Works.

In this method a lathe dog (4) clamps a V-block (2)—machined to hold a cutting tool (6)—to the lead screw nut (7). In effect the nut becomes a die with a single point cutting tool when a tool bit, ground to fit the thread, is inserted in the V-block and locked with a setscrew (3). The tool will clean burrs and bumps preceding the nut, which is held stationary by a long lever (1), while the screw (5) is driven by a lathe.



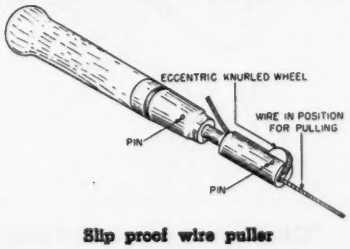
Sketch showing method of repairing lead screw

Since few shops are equipped to machine such long pieces, the usual procedure is to file off the deformities. This involves considerably more time than the proposed method of repair, which can sometimes be performed without disassembling the screw.

Slip-Proof Wire Puller

AN EASILY constructed wire puller, devised by Carl Schreck of General Electric's Schenectady Works Regulator Division, has improved the method of tightening locking wires. The puller is easier to handle and much safer than the conventional method, tightening wire with pliers, especially for women who are now doing the job.

A knurled, eccentric wheel ⅛ in. thick and ½ in. in diameter is the secret of the new device. It is mounted in a piece of drill-rod with a milled slot to accommodate both the wire and wheel. The wire is threaded into the slot and under the wheel which is then rolled back toward the handle to apply pressure on the wire. The grip is automatically increased as the operator pulls the tool to tighten the wire.



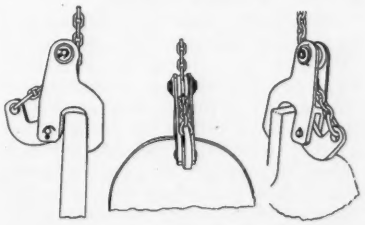
Slip proof wire puller

The drill-rod is approximately 2½ in. long of ½ in. stock. The shank end, however, is turned to a ¼ in. diameter and is fitted and pinned in a wooden handle. The pin, knurled wheel, and rod should all be hardened.

Lifting Clamp for Irregular Pieces

A LIFTING CLAMP, devised in General Electric's Lynn-River Works Forge Division, for forgings, plate stock, and other irregular-shaped pieces, makes possible faster and safer handling than the conventional chain-sling lifting method.

The device is approximately 12 by 15¾ in, weighs about 50 lb and will lift up to 1000 lb. The clamp has an inverted Y-shape jaw, one side of which is formed by a cam lever operated on a ⅞-in. drill rod by a ⅜-in. lifting chain. Teeth are cut into both jaws, and the beveled cam lever automatically adjusts the clamps to accommodate objects with edge sizes from 2¼ to 3¼ in.



Lifting Clamp for Irregular Pieces
Left. Side elevation of clamp lifting turbine bucket wheel. Center. Rear elevation showing chain assembly. Right. Side elevation of clamp lifting casting

Pieces being handled can be repeatedly jarred against other steel billets, and the clamp will retain its hold. As the tension is taken off the chain, the clamp automatically releases its hold.

Baking Insulating Varnishes With Arc Welders

THE BAKING of insulating varnishes of turbo generators stators called for some "on the spot" thinking for the electrical superintendent of Southwestern Cement Company.

Scheduled maintenance called for the removal of the generator rotor and thorough cleaning by washing the stator winding, and after drying it was decided to apply a heavy seal-

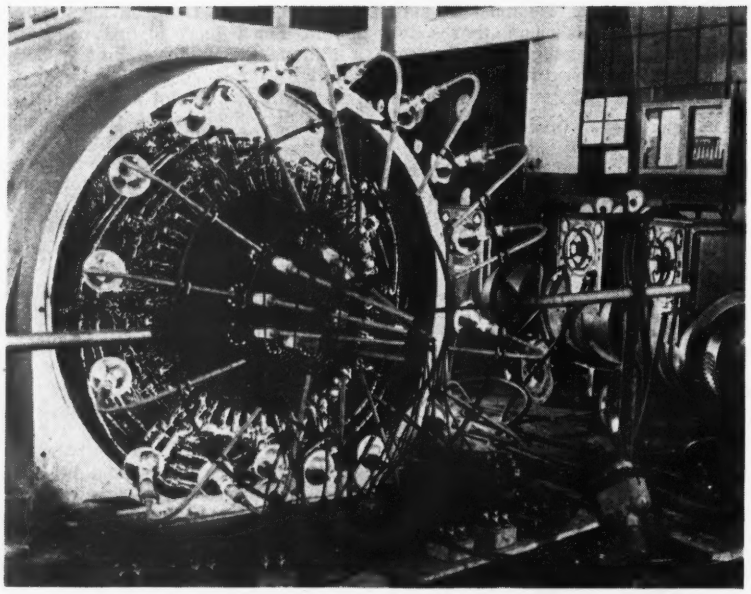


Fig. 1. The arrangement of infra-red lamps used at each end of the generator, which, together with the Hobart arc welding machines (at right), maintained a temperature of 250 F for the 12-hour baking cycle

ing and protective film of long-life, flexible insulating varnish.

Oven baking was not practical and equipment available for baking were infra-red lamps and three Hobart 400 amp electric arc welding machines. It was finally decided to heat the winding internally with direct current from the arc welding machines connected in parallel series and to heat externally with a framework of twenty-four 375 watt infra-red lamps focused in each end of the windings.

The generator winding was connected two parallel star and rated 940 amp per terminal or 470 amp per path. It is desirable to pass current through the entire winding at one

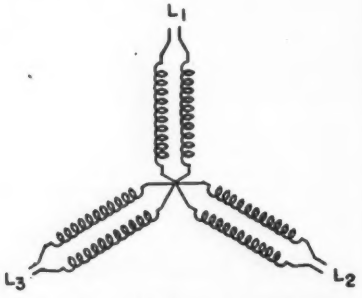


Fig. 2. The parallel star generator winding. Original connections provided cables brought to the outside of the machine from the ends of each circuit of each phase

time, and since each path of the star-connected generator had a relatively low resistance it was evident that as much of the winding as possible should be connected in series. This was accomplished by opening up the star points on the generator winding and connecting all paths in series as shown in Fig. 3. With this scheme only two arc welders were used. The voltage was set at a low

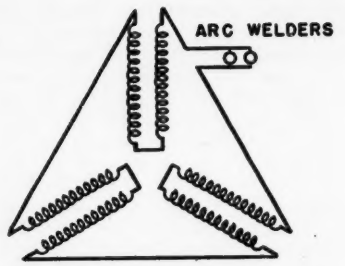


Fig. 3. Scheme of connections for placing the entire generator winding in series and for connecting to two paralleled Hobart arc welding machines

value and slowly increased, allowing ample time for the heat in the copper to be conducted to the outer surfaces of the coils where it could be measured by a thermometer. The current drawn through the generator winding was finally set at 15 volts and 420 amp; and with the two banks of infra-red lamps at each end of the windings, a stable temperature of 250 F was reached and maintained for the required baking time of 12 hours per varnish treatment. A total of three varnish coatings were applied to the generator winding by flooding with an air syphon gun, each treatment being followed by a 12 hour bake.

"Oh, it's you—I thought it was a leak in the chimney flue again!"

HOIST HOOKS— Old and New

By ALEXANDER MacPHEDRON

Naval Architect, Asst. Director, U. S. Maritime Commission

The hook is one of man's most useful devices and one of the most ancient. Man's own fingers are the most primitive form of the device. A hook still remains a hook, however, and, in general, little development has taken place. Simple it is in principle and appearance, yet an intricate calculation is required to mathematically design for a given load.

A hook is primarily designed so that the load is taken on the geometrical center as in Fig. 1.

FIG. 1

While the load is thus imposed, the hook is in stable equilibrium, but when the load is displaced from any cause toward the opening such as by deflection, sway, or impact there is a great change in the situation. This action is shown in Fig. 2.

FIG. 2

The stress is much intensified and the risk of the load jumping the hook is much increased.

As an illustration of the principles governing the stresses on a hook let us suppose a hook constructed from plates as in Fig. 3.

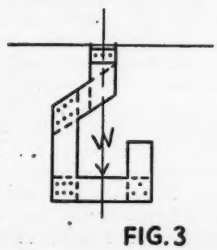


FIG. 3

It will be noted that the hook thus made is of the nature of a cantilever suspended from a cantilever. The conventional cantilever has a rigidly fixed, built-in end but the cantilevers shown have a small degree of fixity, and little resistance, comparatively, against turning around their points of support.

Suppose, however, we take the hook shown in Figure 3 and insert a tie, as in Fig. 4; the whole picture is changed. We have now, in effect, a beam positively supported at both ends, with great reduction in stress and an increase in stability.

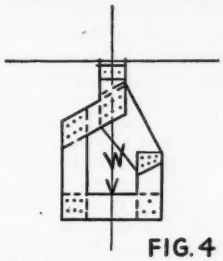


FIG. 4

This latter effect is exactly that provided by the ACLC* Safety Hook, constructed as in Fig. 5.

FIG. 5

These hooks are so devised that when the deflection point is reached the safety tie comes into play supporting the point of the hook and imparting the safety measure before mentioned.

It is an ancient practice to "mouse" a hook, by passing several parts of rope around it. This is done as in Fig. 6.

*American Chain Ladder Co.

FIG. 6

This mousing provides a measure of support to the hook and a precaution against the sling jumping the hook. At its best, however, this device is unsatisfactory due to various causes, such as stretch of the rope. Its application consumes time and it is entirely impracticable for regular handling of loads, such as in loading and discharging cargoes.

The ACLC Safety Hoist Hook, on the other hand, automatically engages and disengages as the load is applied and released, respectively. Entirely automatic and simple in operation it provides just as rapid handling and a higher degree of safety than the common cargo hook. Because of the ACLC Hook's patented shoulders and lip, the load is distributed between these two points. Results, wide safety margin; load won't shift even if the bolt shears. This ACLC Hook will find favor with progressive persons responsible for lifting operations and will yield dividends in the form of preventing accidents and providing ease of mind.

Locating a Fault After Proving It Exists

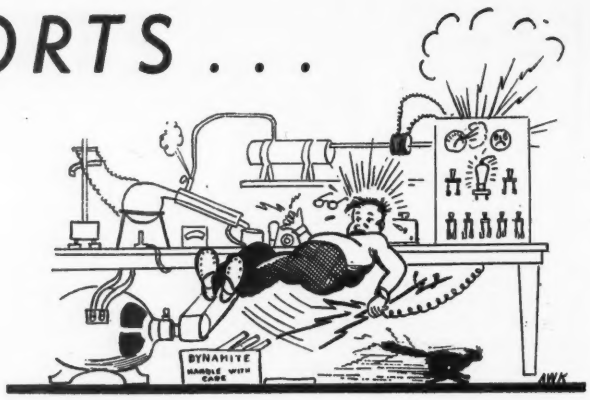
ONE OF THE PROBLEMS in making a high-voltage test of any electrical insulation is, having proved a weak spot exists, to locate exactly where the spot is.

Formerly it was the practice when a fault was indicated to remove the high-voltage excitation and connect a relatively low-voltage, high-current transformer to burn the insulation noticeably around the fault. The relatively low voltage of the fault-burning transformer often was not sufficient to re-establish the arc in the fault. In the new set developed by Westinghouse, a fault-burning transformer is connected across the fault immediately after the breakdown at high voltage occurs and before the tiny arc initiated by the high voltage is extinguished. In addition, a high-frequency arc-stabilizing current is used to maintain the arc during the current zero of the 60-cycle power.

The high voltage is continuously adjustable from zero to 3000 volts or zero to 6000 volts depending on which range is selected. The high-voltage test circuit can be used without the fault-burning feature when desired simply by the operation of a two position toggle switch.

CHINA IS LOOKING FORWARD to rapid postwar industrialization with the emphasis on heavy industries—power plants, chemicals, railway and highway transportation, aviation and port facilities. Partially as a result of a shortage of private industrial capital and the absence of a vigorous industrial class, according to a Twentieth Century Fund publication, industrialization will proceed under state guidance and to a large extent under state ownership and direction.

SHORTS . . .



INSTEAD OF JUST dropping abrasive grains an animal glue coated backings, one manufacturer uses electric charges to stand the abrasive grains on end, and to space them regularly. This process stems from the fact that the most efficient grains are twice as long as they are wide.

* * *

SANDPAPER IS A comparatively recent product of civilization. The first abrasive in sheet form was shark skin originally used in the 12th century. The Chinese, a hundred years later, attached powdered sea shells to parchment with natural gums to make a crude sandpaper. Later the Swiss used ground glass coated to a hide for wood finishing. Sand and glass were glued to paper on a commercial scale in England about 350 years ago and in 1825, the first sandpaper factory was established in this country, making glass coated sandpaper. Abrasive grains used today are not sand but crystolan (silicon carbide), alundum (aluminum oxide), Garalum (aluminum oxide), and others. All of these synthetic abrasives are products of the electric furnace and in hardness approach that of the diamond. With garnet, flint, and emery carefully sorted for grain sizes, and firmly anchored to paper, cloth, and fiber backing with animal glue, they come to the market in the form of belts, discs, and special shapes.

* * *

STRUCTURALLY, wood has the tendency to warp and check under different climatic conditions. To overcome this, it is sawed into narrower strips and glued together. In this way, the tendency of the part to twist out of line is counteracted by the other parts glued to it. This is the reason tops of work benches are made of narrow strips glued together rather than one solid wide plank. When the wood fibers are cut through they can only contract and expand over a smaller area and the less the distance between the cuts, the less contraction and expansion, and therefore less warping. There is no loss of strength either. Joints made with animal glue, for example, have a tensile strength of better than 5000 lb per sq in., twice as strong as wood itself.

* * *

FROM 1902 TO 1940 the capacity of electric generators for public sale increased about 35 times, electric output about 58 times, and the revenues of the power industry about 29 times, according to the Twentieth Century Fund.

* * *

TODAY ALL COUNTRIES are planning to improve the economic and social conditions of the masses of the people. A Twentieth Century Fund survey indicates that in the advanced industrial areas, especially the United States, the British Commonwealth of Nations and Western Europe where the memories of the depression years are still fresh, emphasis is on "full employment" and "social security." The USSR and the less industrially developed areas, for example Latin America, India and China, stress the idea of "higher living standards" through more production and greater productivity.

* * *

A TWENTIETH CENTURY FUND report shows that the war has turned India into one of the great industrial nations of the world. The number of industrial workers increased from 1,737,000 in 1938 to 2,727,000 in 1940, roughly 57 per cent. By the middle of 1942, the production of steel had reached the rate of 1,250,000 tons a year.

* * *

IN MAKING voltage surveys in industrial plants, there are two general methods available. One employes two voltmeters and the other requires only one meter. The two voltmeter method employs two voltmeters with ranges sufficient to measure the highest operating voltage of the system. One voltmeter is connected to the terminals of the apparatus under test and the second is connected to the same circuit at branch circuit junctions and, where possible, to the switchboard or source of supply. This determines the drop between these points.

Since this method requires simultaneous readings some communicating systems such as a portable telephone must be devised so that the person in control of the test may record the voltage at each instrument at the same time. Both instruments must be calibrated to read alike and any discrepancy between them must be known and corrected.

Graphic meters also may be used for recording the variations in voltage at several different points.

With the one meter method, voltage tests may be made with a single low reading voltmeter having long leads that will reach between the various points at which measurements must be made. This method is best where the voltage fluctuates because only one instrument is read. As a matter of precaution, the voltmeter should have a double scale and the maximum scale must have sufficient range to measure the operating voltage of the system.

* * *

IN SHOWER rooms and swimming pools the control of athletes foot and other skin diseases by means of foot baths is troublesome and not always effective. A new cement flooring surface has been developed for this purpose. The surfacing material contains cupric oxychloride and the floor when wet releases copper ions which kill most of the germs. Tests by independent bacteriologists indicate it gives good control of bacteria over long periods of time. The bacteria count in four hours was reduced as much as 95 per cent on this new flooring as compared to an increase of 50 per cent during the same period on ordinary concrete.

* * *

COLLECTIVE BARGAINING contracts between workers and employers have recently shown a trend toward regional and national coverage, greater organization of employers, and development of industry-wide collective bargaining—resulting in standardization of labor conditions over wider areas, according to the Twentieth Century Fund.

* * *

IN 1940, the Twentieth Century Fund says, 84 per cent of our population lived in electrically lighted houses. Of the homes wired for electricity by the end of that year, 95 per cent had electric irons, 63 per cent refrigerators, 54 per cent clocks, 49 per cent vacuum cleaners and 35 per cent coffee percolators.

Tight vs. Free-Floating Idlers

By J. R. Kennedy

SOMETIME AGO I watched the motions of a "free-floating" or slack idler in a large milling establishment. This particular idler was in use on a rubber belt pulling or driving a mill, with gas-engine power. It consisted of a large pulley fastened in a wooden frame, which was suspended between two posts. The thing that amused me was that the idler was positioned in the wrong direction and was "bounc-

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Fig. 1430 Iron Body Gate

Fig. 2125 Bronze Double Disc Gate

Fig. 1640 "King-clip" Gate

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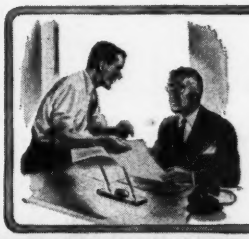

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ing" under the influence of the belt motion instead of being "pulled" downward in such a manner as to tighten the belt. Floating idlers, except when held in position by a counterweight, always rest upon the slack side (or upper side) of a belt; and in general may be said to give the belt more pulley grip on the faces of the pulleys, provided the length of the belt is such that it is not too "tight" before idler pressure is applied; but the idler I refer to above was bouncing at each exhaust of the engine, causing slackness, I believe, right at the moment when the most power was being delivered. In other words, the belt was running "under" the idler (bouncing it upward) instead of running "against" it and sucking or pulling it tightly downward against the belt, thus tightening the latter when the peak of power delivery was reached. It was obvious that the idler was being improperly used and the effect was noticeable in the operation of the mill, which was running more or less erratically or irregularly in spite of sufficient engine power regularly and continuously delivered or transmitted to the belt but not to the mill because of improper idler action. I suggested a change which was made immediately, and the effect was evident in the smooth operation of the mill, without further belt-bouncing and poor transmission of power.

Slack or free-floating idlers prevent jerky starting of certain machines, but may permit more slipping than tight ones. I believe tight idlers eliminate slipping to some extent, but result in early breaking due to the belt absorbing "jerks" instead of the idler. It is largely a matter of choice between wear on the inner (pulley) side of the belt, or actual pull and strain on the inner structure of the belt. On the other hand, efficient power transmission must be attained regardless of other effects.

Protect Your Fire Protection

It is evident that a fire protection system that fails to work when it is needed is as useless as no protective system at all. The following pointers made by the Associated Factory Mutual Fire Insurance Companies are of particular importance in keeping fire protection systems in operating condition in locations where severe cold weather prevails

PLANT FIRE PROTECTION is of even more importance than usual these days because the shortage of building materials and difficulties of construction. If a plant or a portion of a plant is destroyed it cannot be rebuilt either quickly or easily. It is necessary as never before to guard against freeze-ups of water tanks supplying fire-protection equipment in regions where cold weather prevails.

The following checks and tests will be of help to any plant engineer in making certain that his fire protection apparatus is always in working order.

Open the small test valve at the top of sprinkler systems.

Tap branch lines with a hammer; a dull sound indicates the presence of ice.

Test drips at low-points on dry-pipe systems to see whether condensation has collected and frozen in the piping.

Test drains on sprinkler risers to see whether underground mains are clear.

Test hydrants by striking the open butt with the palm of the hand—a hollow sound shows the hydrant is clear—or by lowering a small weight on a string into the hydrant barrel.

Take temperature readings at sprinkler tank heaters or risers. On circulating-heater systems, grasp the hot-water pipe and the cold-water return; a noticeable difference indicates good circulation, shows there is no freeze-up. In doubtful cases, it may be necessary to climb the tank.

In the event a check reveals that piping is frozen or fire system is crippled, there are several things to do. If the freeze-up is serious, notify your insurance company; its engineers are prepared to help you with suggestions and remedies.

If a sprinkler system is frozen, lay hose lines into the area, in readiness for the fire which may come at any time. Then shut off and drain the sprinkler system temporarily, open the ends of the sprinkler lines to allow for ice expansion and, if possible, get more heat into the area. In severe cases, it may be necessary to take down some of the pipes to get rid of ice plugs.

If underground mains or hydrants are frozen they must be thawed out. This can be done electrically, without excavating. Get in touch with your public water department, which quite likely can provide the necessary equipment and the proper supervision, which is important in handling the large electric current required.

If electric thawing cannot be arranged, it may be necessary first to locate the frozen section by hydrant flow tests and then dig down to the pipe and build a charcoal fire around it, thereby quickly melting and loosening the ice plug. Under some conditions a flexible steam hose may be used but has limited applications.

Tank freeze-ups usually form a layer of ice across the top of the tank. If such a layer forms a thick, rigid seal and water is then drawn from the tank, a vacuum may be produced under the ice which could cause the sides of a metal tank to collapse inwards. Another danger is that a large mass of ice may break loose and drop through the bottom of a tank, after the water is drawn out. To prevent a vacuum, chop a hole through the ice—and get the heater back into service as soon as possible.

Since almost all approved fire extinguishers are going into service with the army, the navy and top-priority war plants, no new ones may be obtained by other users for the duration. That means that those extinguishers now on your premises must be properly cared for to make them serve.

A 5-Day, 40-Hour Work Schedule

By Chas. W. Parks

I AM ENCLOSING a 5-day, 40-hour week work schedule for the year 1946, which some of the readers of POWER PLANT ENGINEERING may be interested in. This schedule has two minor disadvantages. One is, that a man has to make two short change-overs every four weeks and the other is that the time between days off is irregular. However, the advantages are great enough to off-set these. The advantages of this schedule are that a man never works over five days without a day off and in many cases only three or four. One man does not have to do all of the relief work be-

5 DAY, 40-HOUR WORK SCHEDULE

Days														7-3	3-11	11-7	Off
Mon.	..	28	25	25	22	20	17	15	12	9	7	4	2	30	A	B	C	D
Tues.	J1	29	26	26	23	21	18	16	13	10	8	5	3	31	D	B	C	A
Wed.	2	30	27	27	24	22	19	17	14	11	9	6	4		A	D	C	B
Thur.	3	31	28	28	25	23	20	18	15	12	10	7	5		A	D	D	B
Fri.	4	F1	M1	29	26	24	21	19	16	13	11	8	6		A	B	D	C
Sat.	5	2	2	30	27	25	22	20	17	14	12	9	7		A	B	D	C
Sun.	6	3	3	31	28	26	23	21	18	15	13	10	8		A	B	C	D
Mon.	7	4	4	A1	29	27	24	22	19	16	14	11	9		B	C	D	A
Tues.	8	5	5	2	30	28	25	23	20	17	15	12	10		A	C	D	B
Wed.	9	6	6	3	M1	29	26	24	21	18	16	13	11		B	A	D	C
Thur.	10	7	7	4	2	30	27	25	22	19	17	14	12		B	C	A	D
Fri.	11	8	8	5	3	31	28	26	23	20	18	15	13		B	C	A	D
Sat.	12	9	9	6	4	J1	29	27	24	21	19	16	14		B	C	D	A
Sun.	13	10	10	7	5	2	30	28	25	22	20	17	15		B	C	D	A
Mon.	14	11	11	8	6	3	J1	29	26	23	21	18	16		C	D	A	B
Tues.	15	12	12	9	7	4	2	30	27	24	22	19	17		B	C	D	A
Wed.	16	13	13	10	8	5	3	31	28	25	23	20	18		C	B	A	D
Thur.	17	14	14	11	9	6	4	A1	29	26	24	21	19		C	B	A	D
Fri.	18	15	15	12	10	7	5	2	30	27	25	22	20		C	D	D	A
Sat.	19	16	16	13	11	8	6	3	31	28	26	23	21		C	D	B	A
Sun.	20	17	17	14	12	9	7	4	S1	29	27	24	22		C	D	A	B
Mon.	21	18	18	15	13	10	8	5	2	30	28	25	23		C	D	A	B
Tues.	22	19	19	16	14	11	9	6	3	O1	29	26	24		C	D	A	B
Wed.	23	20	20	17	15	12	10	7	4	2	30	27	25		C	D	B	B
Thur.	24	21	21	18	16	13	11	8	5	3	31	28	26		C	D	A	A
Fri.	25	22	22	19	17	14	12	9	6	4	N1	29	27		C	D	A	B
Sat.	26	23	23	20	18	15	13	10	7	5	2	30	28		D	D	C	B
Sun.	27	24	24	21	19	16	14	11	8	6	3	D1	29		D	A	B	C

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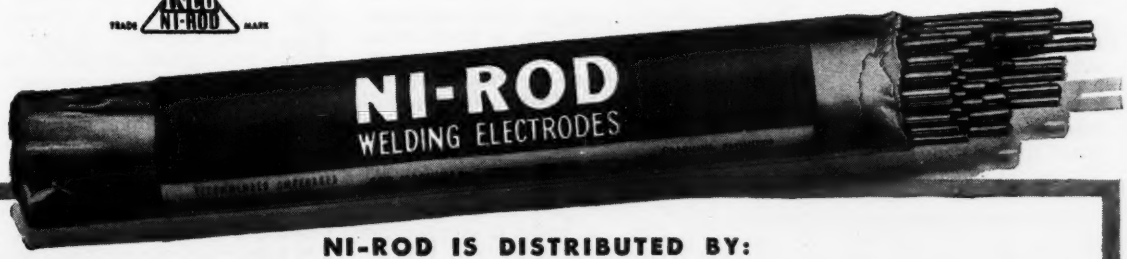

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cause the schedule is so designed that a man works three weeks on regular shifts and then works one week relief. In this way every man has an equal chance. This schedule as shown here is printed for the week starting on Monday, but if your week starts on any other day, merely insert this day at the head of the days column and proceed downward. This will make the men starting the shifts on the day that the week starts. The four crews of men are designated by the capital letters A, B, C and D for which merely insert the names of your men instead. The first three columns are the shifts and the last column indicates the days off. A man can take one look at this schedule and determine what day he will be working or off at any time of the year.

LETTERS AND COMMENTS

Boiler Feed Pump Control

Mr. E. Emerson
Combustion Engineer
March, Cambs
England

Dear Sir:

The portion of your letter[1] to POWER PLANT ENGINEERING magazine for December, 1945, dealing with troubles experienced with ram-type boiler-feed pumps is interesting to the writer in view of similar troubles occurring on recent marine installations. The following comments are offered as a result of recent experience with two high-pressure feed systems.

At least two high pressure feed systems have been designed for merchant vessels within the past five years. The plants are designed for 1200 psig and 1500 psig, respectively; each ship has two boilers.

It is assumed that the trouble experienced with ram packing is due to excessive pressure built up in the pump when the feed regulator closes. Possibly your feed-pump relief valves are called upon to operate a great deal for this reason, and it would not be surprising if you experienced trouble keeping them tight.

A turbine-driven vertical 16-stage centrifugal standby pump and two motor-driven variable-stroke triplex-plunger main feed pumps were provided for one of these ships. Considerable trouble was experienced with the reciprocating pump. The pump stroke was adjusted automatically in accordance with excess pressure (measured across the boiler water-level regulating valve) and had a range from zero to maximum stroke. The operators noted that the stroke control did not accommodate itself to pressure changes resulting from changes in feed-regulating valve position, with the result that ram packing and relief valves wore out rapidly. We believe that part of the trouble was due to having the feed-regulator and pressure-control elements provided by separate vendors with no over-all responsibility for satisfactory operation of the feed system. Later, a special set of valves designed by our engineering department was installed, with some success. The operators, however, prefer to use the standby turbine-driven unit. This has given trouble-free service for three years.

As a result of the experience mentioned above, for another ship we provided vertical 14-stage turbine-driven centrifugal main feed pumps and a motor driven constant-stroke triplex-pluger standby feed pump having a by-pass relief valve actuated by excess pressure. Provision is made for manual motor speed adjustment of the reciprocating pump when operating in port at a prevailing reduced load. The feed system has operated successfully, except that the centrifugal pumps have failed several times due to causes not associated with the system. The pressure governors for the main pumps and the by-pass valve for the standby pump are of the air-pilot controlled type; these were provided by the manufacturer of the boiler water level regulators, which are of the same type.

SABIN CROCKER, JR.

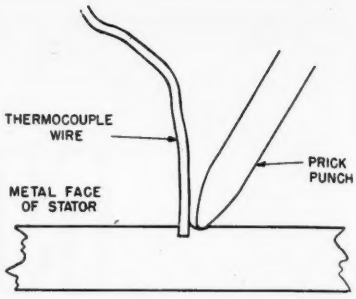
[1]Page 120, December Issue

How to Take a Motor's Temperature

UNDER THE ABOVE TITLE, the article on page 102 of the January issue appears as a digest from the Allis Chalmers "Operation and Maintenance Review." The article suggests cementing an ordinary glass bulb thermometer to the stator iron of the motor by means of a felt pad which covers the bulb, with as much of the bulb as possible in contact with the motor. The article also explains that since the thermometer reading will always be less than the motor's true temperature, arbitrary correction factors must be added. To correct for poor bulb contact, 10 deg C (18 deg F) are added and then another 10 deg C are also added as representing the approximate difference between the temperature of the part tested and the possible temperature of the hottest part of the motor or "hot spot."

Such procedure, no doubt, is sufficiently accurate for motor maintenance but the surprising statement in the article is the following:

"Instead of a thermometer the maintenance man might have used a thermocouple. The lead would then have been attached to the motor part in the same way as the thermometer bulb."



Showing How to Install a Thermocouple

Thermocouples when properly applied are so much more sensitive than thermometers than one might almost compare the above suggested method of using a thermocouple to the use of an alarm clock to check the revolutions of a line shaft instead of a stop watch which happened to be available.

In Part V of "The Boiler Fireman's Handbook" on page 100 of the December, 1945, issue, I described the use of a thermocouple and a potentiometer for reading temperature. I did not, however, describe a method of measuring the surface or near-surface temperature of metals. In the case of the stator iron of a motor, several thermocouples can be applied at any number of points but not by the inaccurate method described in the paragraph quoted above. This implies cementing the hot junction of a thermocouple to the metal surface in a manner similar to that of cementing the glass bulb of a thermometer to a metal.

Instead of such a crude procedure the maintenance man should drill two holes 1/16 in. to 1/8 in. deep into the metal surface of the motor about ½ in. apart, at evenly spaced distances.

These holes should be about the same diameter as the thermocouple wire so that the ends of the thermocouple wires can be snugly inserted in the holes. The next step is to peen these wires into the metal by compressing the metal surrounding the end of each wire by striking the metal about 1/16 in. away from each wire with a sharp pointed prick punch or center punch. If this is properly done the wire cannot be pulled out of the metal. The accompanying drawing shows how this is done. If 5 or 6 thermocouple wires are peened into the metal at evenly spaced intervals around the circumference of the housing, and three or four on the ends and at the bearings, average temperatures may be computed as well as accurately determining the hottest spot. This procedure assures accurate determination of the metal temperature, not immediately at the surface but below the surface as far

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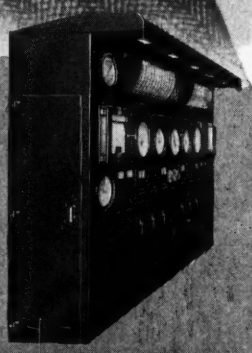
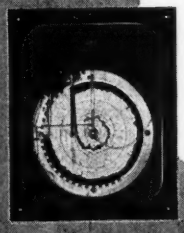
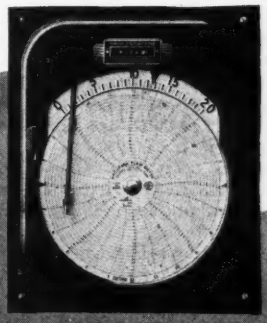


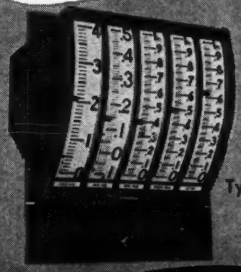
Automatic Combustion Control



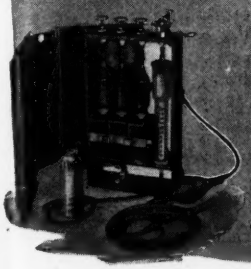
Combustion Meter



HAYS-COCHRANE FLOW METERS



Pointer Type Draft Gages



Flue Gas Analyzers

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COMBUSTION INSTRUMENTS AND CONTROLS

MICHIGAN CITY, INDIANA, U.S.A.

down as the thickness of the metal will permit the depth of the holes.

Iron-constantin thermocouple wire for taking such readings may be of any gage but I would suggest using No. 22 B. & S. A No. 71 or 70 twist drill should be used. Manufacturers of such wire will furnish tables for the conversion of millivolts into either degrees C or F, or they will furnish potentiometers which read directly in degrees C or F.

If any power plant maintenance man or other operator is unfortunate enough to have temperature measuring equipment calibrated in degrees C, he may convert to the Fahrenheit scale by the use of the formula: Degrees F = (degrees C × 1.8) + 32.

Naperville, Illinois J. R. DARNELL

Questions And Answers

Question No. 325

What Packing Should He Use on This Pump?

I AM engineer in charge of a cold storage plant. I have an upright, steam-driven, deep-well pump. I have to pack the plunger of this pump every three months. The packing is of leather and the pump is drawing some sand. This sand is like quicksand. I would like to know if there is some other packing I can use instead of leather. It would save me from packing every three months. The pump runs fast as the packing wears. We are using this pump 24 hours a day now.

Pittsfield, Mass. J. L. C.

Question No. 326

Data Wanted on Pulverizing and Burning Coke Breeze

I WOULD APPRECIATE finding out what other engineers are doing in the particular field of pulverizing metallurgical types of coke breeze for boiler firing. Here are some questions about it that I would like to have answered:

1. What has been your experience in pulverizing coke breeze for direct use, without mixing with pulverized coal, for boiler firing?

2. If you fire pulverized coke breeze in combination with pulverized bituminous coal, in what percentage are the two fuels mixed? Do you use the same burner and, if so, what about primary air supply?

3. What type of pulverizer do you find satisfactory for pulverizing coke breeze from a point of view of fineness as well as power consumption and operating maintenance costs?

4. Do you fire coke breeze direct from the pulverizer system or deliver it to a bin feed system?

5. What hourly quantity of coke breeze do you pulverize (alone) and is the operation continuous?

6. Since coke breeze is an extremely low volatile fuel, what procedure do you follow, when firing coke breeze alone, to hold stable ignition?

7. For successfully firing coke breeze, what type of special burner do you use?

This is a relatively old subject and it seems logical to believe that some POWER PLANT ENGINEERING readers have developed some worthwhile procedures in burning coke breeze as boiler fuel other than by the conventional method of the chain grate and/or spreader type stoker.

Youngstown, Ohio P. R. D.

Answer No. 304

How About a Corliss with 3 Eccentrics?

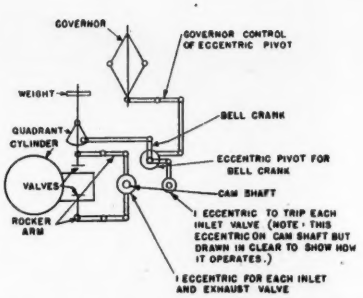
How About One with 6 Eccentrics? Asks Livingston

When I first read this question, I did not write a reply, for I understood that the question applied to a pure Corliss engine, with three eccentrics operating the valve gear on each individual cylinder, and I had no actual experience with such an engine. I surmised that the third eccentric had something to do with the cut-off which surmise proved to be correct.

Now, if you are allowing the discussion to become a free-for-all for everything with three eccentrics, you are going to take in a lot of engineering territory.

Beginning with air-compressors and vacuum pumps, they are quite common (or were in the days before feather valves and steam-jet air-ejectors came into use.)

The side-wheel ferry-boat San Pedro, on San Francisco Bay, has a two-cylinder, inclined, compound engine. Each cylinder has two eccentrics operating a Stephenson link motion, from which a reach-rod leads to a Corliss wrist-plate. From the wrist-plate, four reach-rods operate poppet inlet and exhaust valves through a Sickles valve gear. A third eccentric trips the inlet valves, the point of cut-off being regulated by a hand-lever at the control platform.


GOVERNOR
GOVERNOR CONTROL OF ECCENTRIC PIVOT
WEIGHT
BELL CRANK
QUADRANT
CYLINDER
ECCENTRIC PIVOT FOR BELL CRANK
VALVES
CAM SHAFT
ROCKER ARM
1 ECCENTRIC TO TRIP EACH INLET VALVE (NOTE: THIS ECCENTRIC ON CAM SHAFT BUT DRAWN IN CLEAR TO SHOW HOW IT OPERATES.)
1 ECCENTRIC FOR EACH INLET AND EXHAUST VALVE

Sketch by Howard T. Livingston showing operation of poppet valve gear by 6 eccentrics per cylinder—3 on each end—on San Francisco cable car poppet valve engines

In the case of the engines with poppet valves operated by eccentrics from a cam shaft, there were four eccentrics to a cylinder.

In cable car days in San Francisco, some of the cable power houses had engines with six eccentrics per cylinder. It is a number of years since I saw one of these engines in operation, but I will draw a sketch of the valve gear as well as I can remember it.

Inlet and exhaust valves were operated by eccentrics and rocker arms, as shown in the lower valve gear. On the inlet valve stem, a quadrant was pivoted. This quadrant was swung in a segment of a circle by a third eccentric through a bell crank. The pivot of the bell crank was an eccentric mounted on a shaft that could be rotated through an angle by a linkage from the governor. The eccentric would raise the inlet valve stem by a roller on the end of the rocker arm lifting the arc of the quadrant. The third eccentric would swing the quadrant until the roller slipped off the quadrant, allowing the valve to drop to the closed position. The governor, by shifting the eccentric pivot, would vary the point at which the inlet valve would close, thus controlling the point of cut-off.

I have shown the third eccentric to one side of the cam-shaft to make the illustration clearer, but actually it is operated by the same cam shaft as the other two, and in line with them.

The valves were seated by weights, and not by springs.

HOWARD T. LIVINGSTON

Los Angeles, Calif.

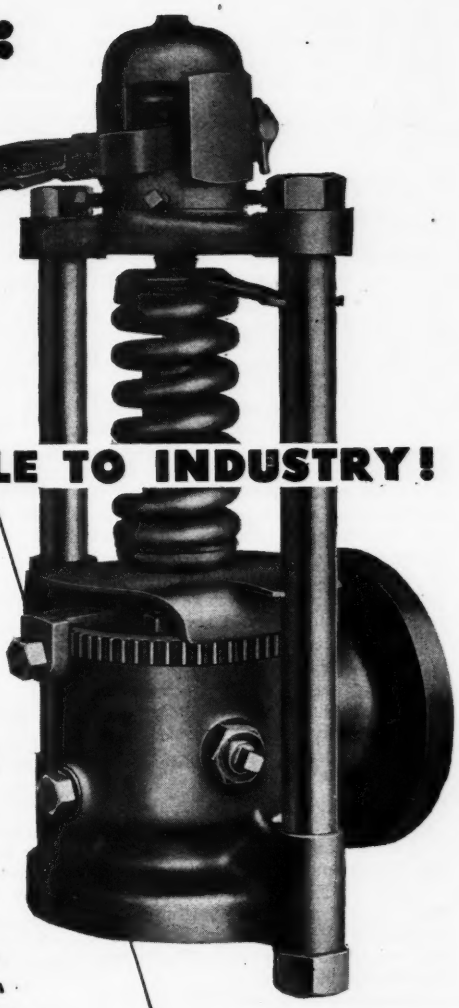
Answer No. 312

What Happens When Air and Water Meet?

Air at Atmospheric Pressure Heavier Than Steam

THE MISSING 6890 grains in this question is mostly the weight of the air itself, that is, the oxygen and

THIS REVOLUTIONARY* NEW SAFETY VALVE IS NOW AVAILABLE TO INDUSTRY!



More than 6 years ago the Foster 38-SV Safety Valve was developed especially to meet the trend toward higher operating pressures and temperatures.

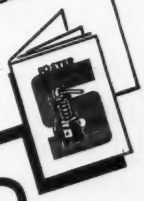
The problem was approached with a thorough understanding of the factors involved — *plus* — a good healthy dissatisfaction with the shortcomings and limitations of conventional safety valves. As a result, the design of the new Foster 38-SV is revolutionary and its performance characteristics are phenomenal.

A few of the advances: constant popping point regardless of changes in temperature; full opening practically instantaneous with less than ½% accumulation; tight closing as little as 1% below popping point; blow-down adjustable as low as 1%.

Since the first installation early in 1940, more than 100 Foster 38-SV Safety Valves have been working at pressures up to 2575 pounds and at temperatures up to 1000° F. And during the war, all we could make went into installations vital to the war effort.

Foster Type 38-SV Super-Jet Safety Valve for pressures from 400 to 3000 pounds at temperatures up to 1000° F.

NOTE:
Now Foster 38-SV Safety Valves are available to Industry again, and Bulletin 25, describing them, will be sent promptly on request.



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PRESSURE REGULATORS...RELIEF AND BACK PRESSURE VALVES...AUTOMATIC STOP AND CHECK VALVES...ALTITUDE VALVES...DAMPER REGULATORS...FAN ENGINE REGULATORS...PUMP GOVERNORS...TEMPERATURE REGULATORS...LIQUID LEVEL CONTROLLERS...FLOAT AND LEVER BALANCED VALVES...NON-RETURN AND TRIPLE DUTY VALVES...VACUUM REGULATORS OR BREAKERS...SIGHT FLOW BOXES...STRAINERS...SAFETY VALVES...SIRENS

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nitrogen which we usually say comprise 20 per cent and 80 per cent respectively of air's composition, neglecting moisture, argon, neon, helium, krypton, xenon and varying small amounts of CO and CO_2.

Dry air consists principally of nitrogen and oxygen in proportions, by weight, of 75.45 per cent and 23.20 per cent respectively. The balance is 1.25 per cent, by weight, of argon and smaller proportions of the other elements named above. The proportions by volume are 78 per cent N., 21 per cent O, 0.93 per cent Argon, 0.04 per cent CO_2 and the balance helium, with traces of other light elements.

We seem not to be surprised that steam has weight, probably because we have it demonstrated that the water it comes from has weight, while we seldom see liquid air, which is heavier than water in even volumes. At atmospheric pressure, it takes about 37 cu ft of steam to weigh 1 lb but only about 13.5 cu ft of air. This is demonstrated every time you turn steam into a cold radiator; the bottom heats up last, because air has weight and settles to the bottom.

Pittsburg, Kan. S. A. HADLEY, Asst. Engineer, Mechanical, Jayhawk Ordnance Works

Remember This Is a Mixture, Says Moulton

EVIDENTLY H. H. L. has lost sight of the fact he is dealing with a mixture of air and water vapor.

Air at 70 F dry bulb and 70 F wet bulb means saturated air, that is, air containing all the moisture it can hold. The relative humidity is 100 per cent. Barometer 29.92 in.

According to the hand book on air conditioning issued by POWER PLANT ENGINEERING, air under these conditions has a volume of 13.69 cubic feet per pound and a water content of 0.01578 lb. Expressed in grains, this equals 0.01578 × 7000 or 110.46 grains of water. Then 1 lb of the mixture would contain 110.46 grains of water and 6889.54 grains of air, making 7000 grains in all.

Pittsfield, Mass. ALBERT H. MOULTON

Answer No. 314

Can He Use Green Bean Water for Boiler Feed?

Did You Ever Clean a Bean Soup Pan?

MY SUGGESTION is to forget the possibility of using this bean water for boiler feeding. True, the water may be filtered and conditioned but this will result in an increased labor and maintenance cost that may effect the savings realized from the Btus salvaged from the bean water. Also the residual, if any, that may remain in the feedwater forms a very stubborn substance to remove and when this pesky stuff gets into the system it may reduce the efficiency greatly.

In my opinion the best thing to do is to look back through the pages of past issues of POWER PLANT ENGINEERING where you'll find quite a number of ways this heat may be reclaimed. Frequency of cleaning the filters and conditioner, first cost and depreciation of equipment, and efficiency of equipment are important factors to be considered. Did you ever clean a bean soup pan?

Buffalo, N. Y. THOMAS B. BREEN

Save the Heat with a Heat Exchanger

ANY WATER that is not clear cannot be considered satisfactory for boiler feed because the color is due to suspended matter, part of which will be deposited in the boiler and part carried with the steam because of foaming, which also will be the result of the suspended matter.

The three conditions that a water must meet to be fit for boiler feed are as follows:

1. The suspended matter must be less than 10 ppm. In the absence of a turbidity indicator, this means that the water must be crystal clear.

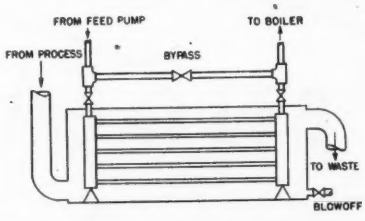
2. The pH must be 8. Not over 9 nor under 7.

3. The hardness must be less than 15 ppm.

I am aware that many boilers are being operated without regard to any of the above conditions and apparently without any trouble, but there can be no doubt that in the long run the money wasted in such boiler rooms is many times the cost of using some kind of treatment.

Your correspondent is interested in clarifying the water and considering that this is a small plant with very large amount of contaminated waste hot water in proportion to the boiler feed, the most economical solution of the problem is to recover the heat of the waste water by means of a heat exchanger.

If the temperature of the present feed water is 60 F and that of the waste water 200 F, the heat recovery possible is 140,000 Btu per 1000 lb of boiler feed. The average temperature of the feed water will be 130 F and the temperature difference 70 F. The capacity of the heat exhanger will be 70,000 Btu per sq ft per hr. which calls for a heat exhanger of 2 sq ft per 1000 lb of boiler feedwater.



Sketch by N. T. Pef shows heat exchanger suitable for large amounts of dirty hot waste water. Heat exchanger element is immersed in tank of ample size, either concrete or steel, through which waste water flows by gravity

Since the waste hot water available is dirty and in large quantities, the most economical arrangement would be to place the bundle of heat exchanger tubes in a large tank, either steel or concrete, which should be properly convered. Through this the waste hot water can flow by gravity to waste. The saving in fuel will be about 12 per cent.

Boston, Mass. N. T. PEF

Don't Use It without Full Information from a Feedwater Expert

WATER FROM various contact processing operations, such as the bean water mentioned, should only be used for feedwater on the advice of an expert chemist. My advice to R.M.S. is to send a sample of the water to a reputable laboratory for a complete chemical analysis and then turn this report over to a cometent feedwater consultant for pretreating before feeding it to the boilers. This is the only safe and sure way to prevent trouble. The cost of the analysis and the advice might be cheap as compared to the trouble that could be caused.

Green plants draw from the earth the following elements; carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulphur, calcium, iron and magesium. All of these are undesirable in boiler feedwater for one reason or another. Just how many of these or how much of these are held in solution in the water or just what chemical reactions have taken place can only be determined by an expert chemist. This water may be perfectly harmless and then again it may be very dangerous. It don't pay to take a chance. I believe that this water will cause trouble if not treated properly.

Baltimore, Md. CHAS. W. PARKS

Answer No. 315

How Calculate Steam Flow Through Slots?

He's a Napier Fan

THIS WRITER has a very high regard for Napier's formula under the conditions as set forth by J.R.D. and believes the formula will be found quite satisfactory.

The reason why the writer thinks so well of Napier formula is this: In college the professor of mechanical engineering gave us a "test" in which there was an orifice that we had never seen and we knew nothing about its shape or size. The problem was to determine the size of the opening without seeing it, based on Napier's formula.

In the test, we measured the steam pressures on the pressure side and on the exhaust side and condensed the steam in a condenser. We weighed the condensate.

Thus, referring to the formula, which is given by J.R.D. on page 120,

AJAX

GASKET-ENGINEERING FACTS

PATENT PENDING

AJAX Spiral Wound Gaskets are made for every operating condition. Physical dimensions are established by flange design, while variable requirements, such as bolt loading and compressibility are met by controlling the type of material used and the number of spiral wire and filler plies.

The AJAX method of gasket construction eliminates the possibility of joint failure as a result of bolt relaxation, since the resiliency of the gasket permits it to act as an expansion member.

YOU GET LONG-TIME SERVICE ECONOMY WITH THE *AJAX "S-R" GASKET* AND LOCATING RING BECAUSE—

1. The AJAX steel Locating Ring accurately centers the gasket in the flange.
2. The AJAX Locating Ring acts as a gauge to control applied bolt stress at point of installation. When flange bearing surfaces are drawn up tight against Ring, complete, positive seal at correct seal pressure is assured, regardless of operating temperatures and pressures. Thickness of compressed gasket is always .125" + .010".
3. The AJAX Locating Ring completely encompasses and confines the gasket proper, so that total, instantaneous, failure of AJAX-sealed joints is virtually impossible.
4. The specified diameters of AJAX Locating Rings prevent installation of incorrect gaskets.
5. The resiliency of AJAX "S-R" Flange Gaskets permits their re-use.
6. AJAX "S-R" Gasket construction automatically compensates for pipe line stresses.

"THE STORY BEHIND THE GASKET THAT BREATHES"

Note on this cutaway drawing, the small air space under each U-groove in the metal ply.

There are twin strips of asbestos filler between each spiral thickness in the AJAX Gasket which cannot meet in the center under the wedge-like groove. Therefore a "breather-space" is preserved in the heart of the gasket which assures its automatic reaction to mechanical compression, to internal pressure variation, and to temperature changes.

The AJAX Gasket expands and contracts — "breathes" — with changing pressure conditions — and retains the positive, secure seal you require at all times.

The above cutaway is the AJAX S-R Compression Gauge Flange Gasket

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AJAX "S-R" Flange Gaskets assure true "installed economy". . . constant, trouble-free service under your toughest operating conditions.

Write today for complete AJAX data to

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we knew W and p but we didn't know a.

In solving for "a" this writer's answer was "perfect." So, naturally, he has always been a Napier "fan" ever since his college days.

Newark, N. J. W. F. SCHAPHORST

Answer No. 316

How Detect Contamination of Heater Condensate by Oil?

Filter Pressures Will Detect It

IT WOULD APPEAR possible to "rig up" a device that will take care of the situation, as follows:

Install a good feedwater filter in the line—the type that employs "cloths" or similar devices for absorbing the oil. Place a pressure gage ahead of the filter and another pressure gage behind it so that the pressure drop through the filter can be observed at all times. When the filter is clean it will be found that the pressure drop is slight. If oil accumulates in the filter cloths, a pressure drop will increase.

If desired a curve can be plotted between time and dirtiness, based on the pressures, which will enable E.H.R. to know with surprising exactness the amount of oil in the cloths at any time after installation. The curve, then, together with the gages, can be made to serve as an "indicator."

The problem as given by E.H.R., though, is even simpler than the above. He does not want any oil to enter the line at all. Therefore, as soon as he notices the slightest increase in friction, he would know that a leak existed and he would take the necessary corrective steps.

Newark, N. J. W. F. SCHAPHORST

Use Oil Separator with Electrical Alarm and Controls

THE TYPE OF OIL flowing through the heater is not mentioned, but, on the average, I think we can be safe in assuming: that its specific gravity is lower than that of condensate, so that it would be readily discernible at the top of a water glass; that its transparency would be less than that of condensate; and that its electrical conductivity would also be much less than that of condensate.

As most condensate is impure, containing ionizable gases and solid matter, the relative electrical resistance across a small gap is not too large. On some samples that I tested, the resistance across a ¼-in. gap varied from 400 to 15,000 ohms. On various oil samples (not emulsified) the resistance was practically infinite.

If the above assumptions hold true in E. H.'s case, then one of the following schemes might solve his problem.

A gravity type oil separator can be made as illustrated in Fig. 1. The capacity should be several times that

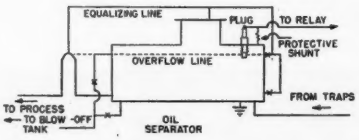


Fig. 1. Sketch by Erisman showing how oil separator can be connected to show contamination of heater condensate by oil

of the heater traps in order to insure a quiet flow of condensate through it and to provide time delay for better oil separation, also to prevent stirring up of rust deposits, etc.

A seal is provided so that the separator is always full of condensate. Since the outlet flow is from the bottom, oil will separate and rise to the top, where it is trapped. (I am assuming that if an oil leak occurred, the oil would not be agitated with the condensate long enough to cause emulsification).

With an oil separator of this approximate size, it should not be necessary to provide automatic closing of the oil and steam valves, although it could easily be done by using solenoid or motor operated valves, relay controlled from either one of the following schemes.

As shown in the drawing, Fig. 1, an automobile spark plug is screwed into the top so that the electrodes just extend below the overflow line of the seal. Seal, separator, and sight glass levels are kept on the same horizontal by means of the equalizing line. This line also prevents spyhoning through the seal.

In Scheme No. 1, Fig. 2, the alarm is actuated when the leaking oil rises in the separator and displaces the condensate covering the electrodes, causing the conductivity to be so lowered that the flow of current is insufficient to keep the sensitive relay energized, resulting in the closing of its contacts and the energizing of the alarm.

With condensate across the gap, the 110-v potential will cause a current of several mils to flow, which is sufficient to energize a sensitive type relay. Vacuum tube amplification could be used, allowing the use of lower voltage across the gap, but since the separator is connected to ground, no electrical danger is presented to the operators.

A copper oxide rectifier is used because the sensitive type relay requires dc excitation. The contacts

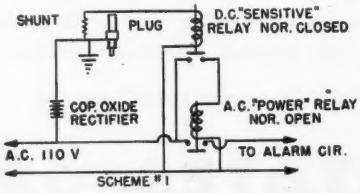


Fig. 2. Scheme No. 1 by Erisman for controlling heater oil and steam valves from separator

of the sensitive relay should match the energy requirements of the operating coil of the power relay.

By experiment, the widest gap can be found that will still allow enough current flow to operate the sensitive relay. The wider the gap, the less apt it is to foul. Frequent cleaning will no doubt be necessary, anyway.

When the alarm sounds, the operator should first check the sight glass to make sure that it is not caused by something other than oil.

The functioning of Scheme No. 2, Fig. 3, depends upon the difference in the amount of light that will be passed through the oil and the condensate in the sight glass and its resultant effect upon the photoelectric tube and its associated amplifier and relays.

When oil appears at the top of the sight glass, the intensity of the light beam falling on the photo tube would be lowered, resulting in operation of the relays, causing the alarm circuit to be energized.

If the oil transparency approached that of the condensate, the light intensity might still be less, due possibly to a difference in refraction. This phase of the problem could be cleared up by consulting the manufacturer of this type of equipment.

The photo tube, relays, and light source can be purchased in unit form and make a cheaper and better job than a "home made" outfit. For that

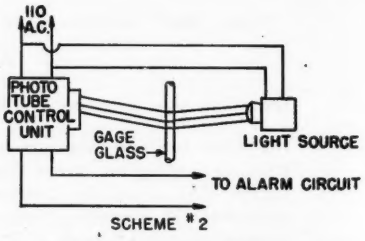


Fig. 3. Scheme No. 2 by Erisman for controlling heater by means of photo tube

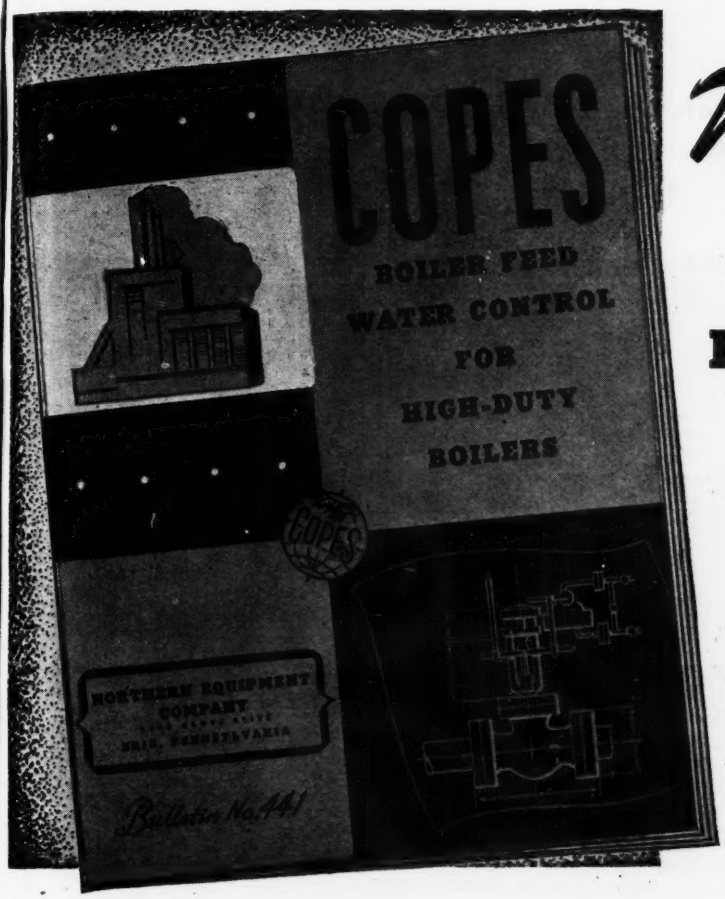
reason I did not include a schematic of the photo tube circuit.

Frequent cleaning of the gage glass may be necessary to prevent sounding of the alarm from a dirty glass.

The separator, for either scheme, can be reset, after an oil leak has been repaired, by using the top blow-off valve and/or the drain valve.

As an after-thought, E.H.R. may be dubious of using Scheme No. 1 because he might think that an explosion hazard might be involved. So I included a shunt resistor across the gap, which would act as a leaker, but would not pass enough current to energize the sensitive relay. This would eliminate possibility of a static charge building up and at the same time it would strengthen the sensitive relay coil.

St. Louis, Mo. JESSE L. ERISMAN



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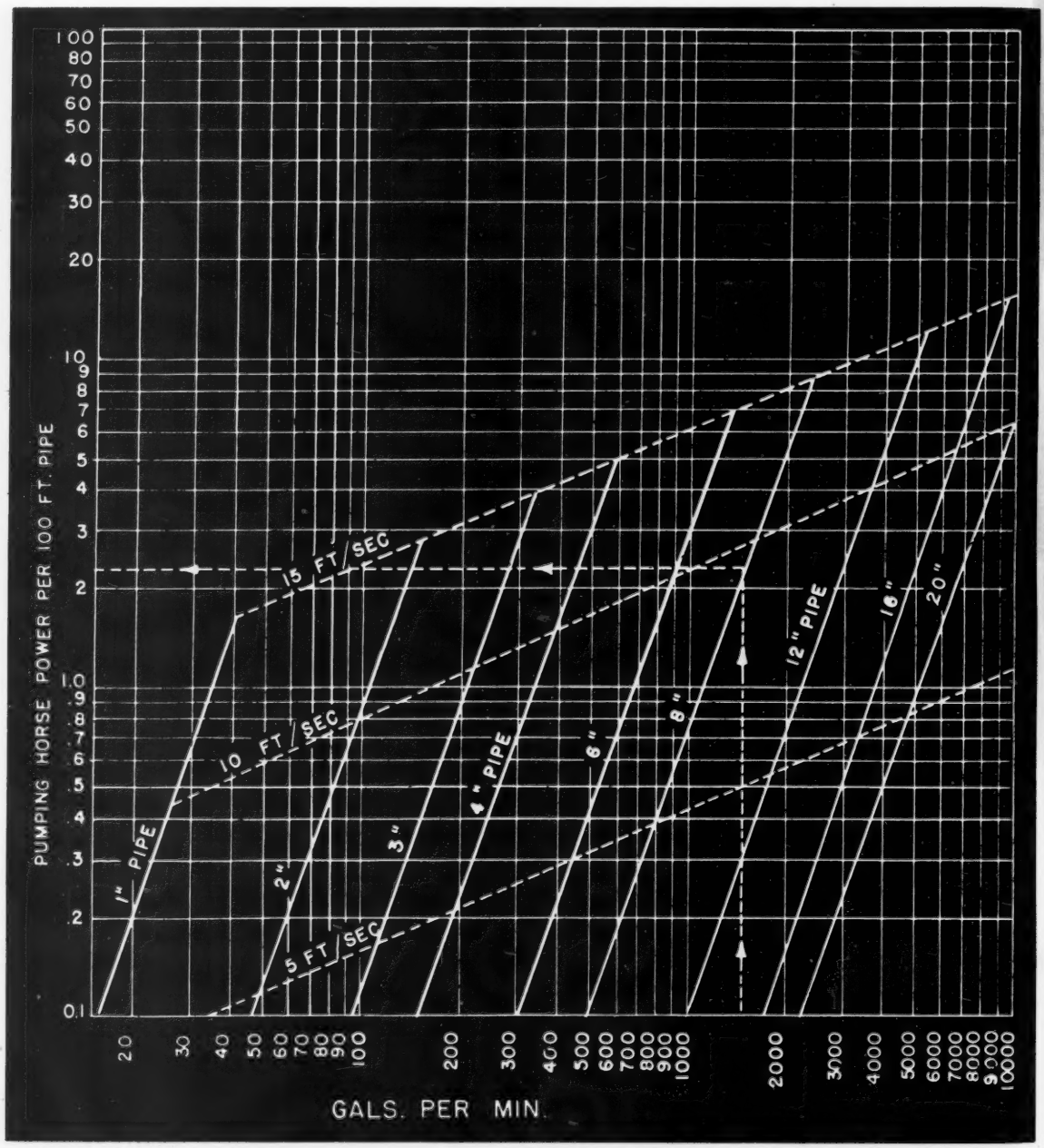
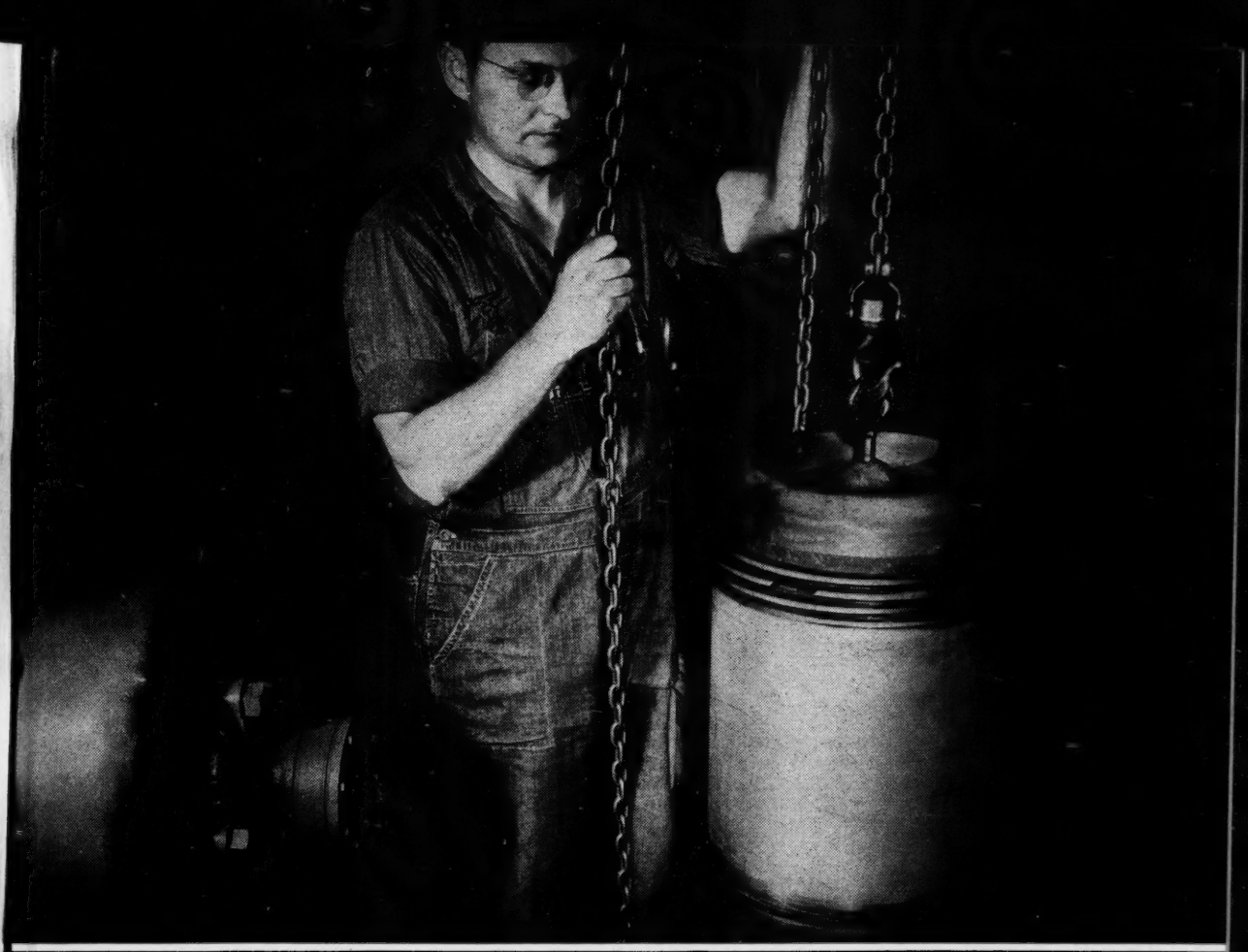
Power Required to Overcome 100 Lineal Feet of Pipe Friction

By Bill Maddock



Head loss charts are not always convincing so this chart showing the power loss has been prepared. It shows the power needed to overcome 100 lineal feet of pipe friction through various sizes of pipes and for various rates of flow. Thsi is a chart that executives can understand



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INDUSTRIAL PRODUCTS

Gas Turbines in the Houdry Process*

By J. E. Evans and R. C. Lassiat

How gas turbo-compressor serves as a non-power-consuming source of high-pressure air for catalyst regeneration . . . Not primarily a power-producer, although, under certain conditions, it does yield excess power . . . Much by-product power in form of 450-psi steam from catalyst case during regeneration . . . Details of Houdry fixed-bed catalyst regeneration and turbo-compressor operation . . . Determination of turbine and compressor gas and air flows, pressures and temperatures . . . Analysis of the effects of seasonal and cyclic variations

TODAY one of the most significant commercial applications of the gas turbine and its complementary axial compressor is in the Houdry Fixed-Bed Catalytic Cracking Process for making aviation and high octane motor fuels. In the fixed-bed plants, which total a third of the Nation's catalytic cracking capacity, the turbo units are not used for their power-producing ability but because they serve as a non-power-consuming source of the large quantities of high-pressure air needed to regenerate and maintain the catalyst at high efficiency.

One measure of the machine's widespread acceptance and utility in this application is the total installed axial compressor capacity which now aggregates more than one million cubic feet per minute. Of the turbo units installed in plants in this country, the earliest machines are still operating after more than eight years' practically continuous use. A recently published plant operating report[1] on six turbo-compressors ranging in age from about two to eight years showed overall operating time efficiencies of 98%, the oldest machine slightly bettering the average.

In the Houdry process aviation and high-octane gasoline are made catalytically by passing vaporized heavy oils through beds of pelleted catalyst. An undesired by-product of the cracking reaction is coke, which is deposited on the catalyst and in its pores. As these deposits impair the catalyst cracking activity, they must be removed after each exposure of the catalyst to oil vapors. This is accomplished by a controlled combustion or regeneration using compressed and preheated air as the oxidizing agent.

In the static or fixed-bed process, continuity of flow of oil and regeneration air is obtained by cracking in one pair of catalyst cases for a given time interval and then switching to freshly regenerated cases. A completely automatic timer[6] and valve system control operations according to a predetermined schedule. In one plant arrangement, multiples of three cases are used, each single case or pair cracking oil for ten minutes, regenerating for ten minutes and being vacuum purged the balance of the 30-minute cycle. In an alternate arrangement multiples of four cases are used, one case cracking oil for 10 minutes while two cases are regenerated for 20 minutes.

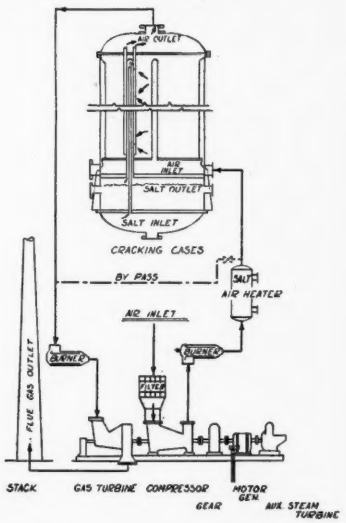

Fig. 1. The Houdry air system

The air for regeneration is supplied by an axial compressor. After compression, the air is preheated to about 750 F and introduced into the cases, where it burns off the coke deposit on the catalyst. Leaving at temperatures between 800-850 F and at pressures above 40 psig the products of combustion pass through the gas turbine which drives the compressor and in addition produces minor amounts of excess power as well.

By regenerating under pressure, several process advantages are gained. First, the regeneration is intensified

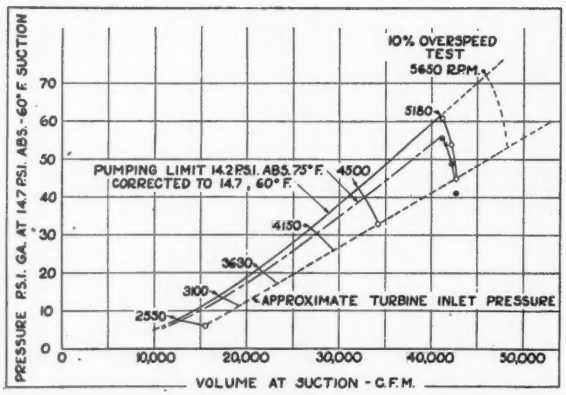

Fig. 2. Turbo-compressor characteristics—40,000-cfm unit

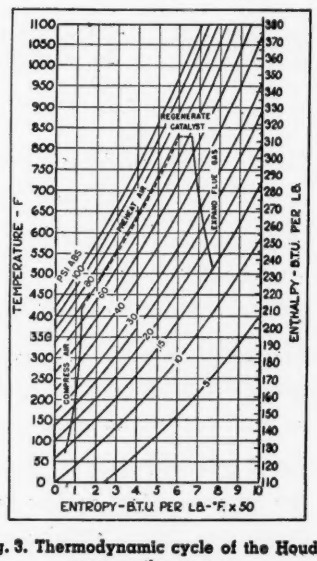

Fig. 3. Thermodynamic cycle of the Houdry regeneration process

*Abstract of an article in the Houdry Pioneer, Vol. I, No. 1.

[1]See references, page 144.

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DIMENSIONS AND WEIGHTS—Fig. 141
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SIZE	¼" & ⅜"	½"	¾"	1"	1¼"	1½"	2"
Center to End	1½	1⅞	2⅛	2⅜	2¾	3⅛	3¾
Center to Top	6½	7¾	9¾	10⅛	12⅜	14½	16¼
Weight—Lbs.	2¼	4¾	6¼	13	19½	31	40

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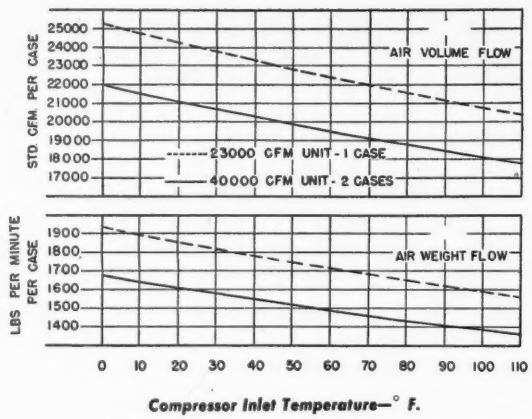
STD CFM. PER CASE
AIR VOLUME FLOW
23000 CFM UNIT - 1 CASE
40000 CFM UNIT - 2 CASES
LBS PER MINUTE PER CASE
AIR WEIGHT FLOW
Compressor Inlet Temperature—° F.

Fig. 4. Houdry air system flow relations

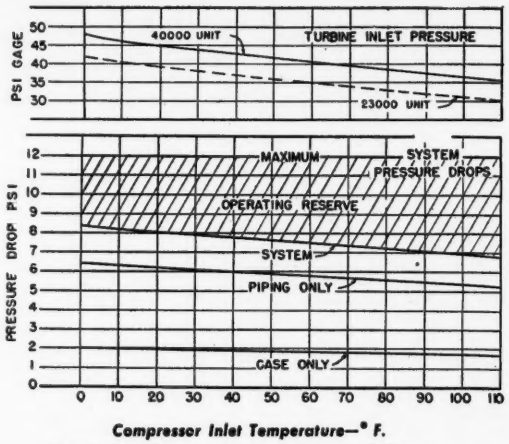

Fig. 5. Houdry air system pressure relations

and speeded up and a more complete removal of catalyst deposit is obtained with consequent improvement in product quality. Second, the air supplied is utilized with better combustion efficiency, resulting in increased burning capacity and gasoline production. Another advantage is that pressurized regeneration permits the use of smaller process equipment throughout the regeneration system without exceeding practical velocities and pressure drops. From a standpoint of excess power generation it is highly desirable to keep the system drop small.

The large amounts of power or its equivalent produced as a valuable by-product in the Houdry plants result from a very efficient conversion of almost all the heat liberated during regeneration into 450 psi superheated steam. To effect this recovery, a molten salt is circulated at temperatures of 800-850 F through tubular heat transfer elements in the catalyst cases. Exothermic heat of regeneration is absorbed thereby and, during the on-stream period, the small endothermic heat of cracking is supplied. By continuously circulating a salt side-stream to the steam generator, the necessary heat is withdrawn from the plant. For simplification, details of this system have been omitted from Fig. 1, which shows only the relation of the turbo-compressor to its auxiliaries and a typical catalyst case being regenerated.

Turbo-Compressor

The 40,000 cfm machine serves six catalyst cases and permits removal of coke deposits amounting to as much as 6,000-6,500 lb per hour.

The compressor is a 20-stage axial machine with a pumping limit or maximum discharge pressure of about 63 psig at rated speed of 5,180 rpm. The turbine is a 5-stage reaction type rated at 6,200 hp at 950 F inlet temperature, inlet pressure being about 42 psi g at normal flow. As usual with this type machine, auxiliary starting equipment is necessary to bring the speed up to about 20 per cent of rated where the machine becomes self accelerating. To bring the unit from this point to full operating speed, the system pressure drop is minimized by paralleling all catalyst cases and bypassing air from compressor to turbine as well. The burner in the line to the gas turbine then is fired to obtain the temperature necessary to accelerate the unit. This generally ranges from 850 F up to the maximum permitted inlet temperature of 950 F, depending on the rate of acceleration desired. After the machine is brought to speed, the burner in the compressor outlet line is fired, as this hot air stream is used to heat up the catalytic equipment.

When cracking operations are begun, firing of both combustion chambers is stopped, the salt heater supplying the necessary air preheat without recourse to the compressor burner. The oxygen deficiency in the re-

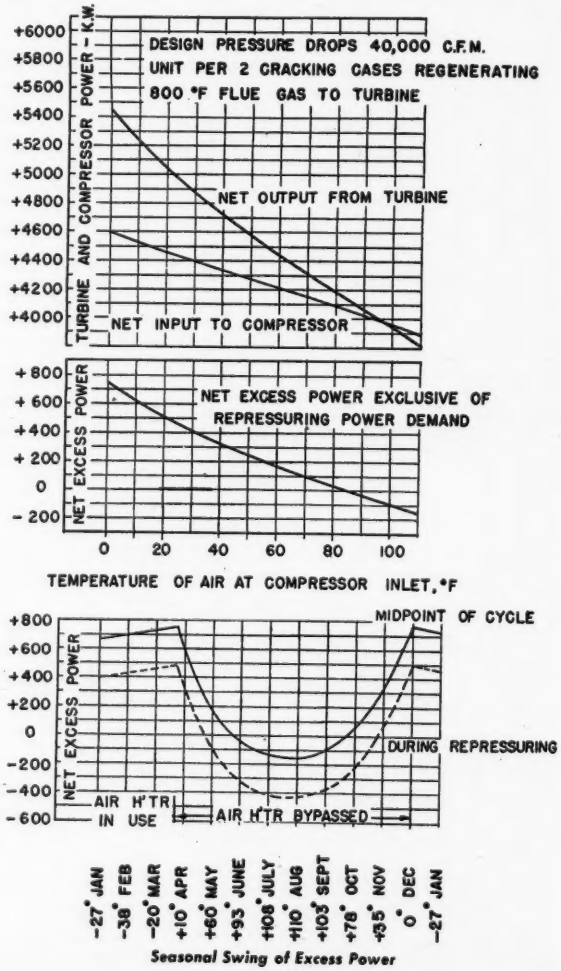

Fig. 6. Houdry air system power relations

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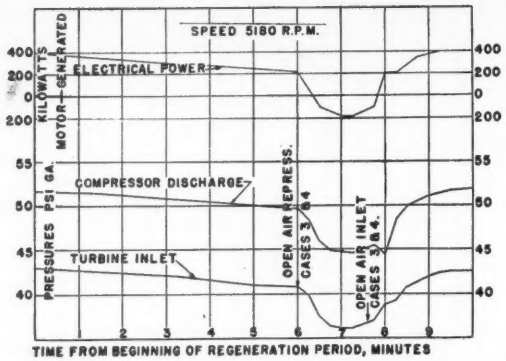

Fig. 7. Turbo-compressor cyclic variations

generation flue gas in the early stages of regeneration makes it unwise to fire the turbine burner, although it would be desirable from the standpoint of producing excess power to have the regeneration flue gases enter the turbine at highest possible temperatures instead of at the 800-850 F level imposed by the process.

Thermodynamic Cycle and Efficiencies

To better visualize the effect of turbine inlet temperature and system pressure drop on compressor and turbine power, the thermodynamic path of the Houdry regeneration is mapped on Fig. 3. As this enthalpy-entropy diagram was derived for air, it is not recommended for the exact solution of process power problems because volumes of flue gas and air are not equal and the flue gas and air physical properties differ appreciably. The increase in volume of the flue gas relative to the air results from combustion of hydrogen in the deposit to water vapor and the burning of part of the carbon to carbon monoxide. As the deposit contains 5-10 weight per cent hydrogen, which apparently burns selectively during the early stages of regeneration, this volume increase is not negligible. About one-third of the carbon burns to carbon monoxide, the exact proportion depending chiefly on type of cracking catalyst used. These volume increases are illustrated by the combustion equations following:

Basis: 1 volume of oxygen.

$C + O_2 \longrightarrow$ 1 volume CO_2

$2C + O_2 \longrightarrow$ 2 volumes CO

$2H_2 + O_2 \longrightarrow$ 2 volumes H_2O

Applying the necessary corrections, power surveys have shown that the adiabatic compressor efficiencies average 81 per cent and turbine efficiencies average 85 per cent in machines in good operating condition.

Turbo-Compressor P-V Characteristics

Since the compressor and turbine rotate at the same speed and handle related volumes of gas, the pressure volume characteristics must be considered in arriving at the overall P-V curve for the set. As will be shown, the only significant items involved at rated speed of 5,180 rpm and usual turbine inlet temperature of about 800 F are: the compressor suction volume which is capable of varying from 41,000 to 42,800 cfm; the turbine inlet pressure which at standard suction conditions can only vary between 43 and 45 psig; and the maximum discharge pressure or compressor pumping limit, which amounts to about 62 psi ga at standard inlet conditions. A graph of these properties of the set is shown on Fig. 2, which is a composite of shop test and plant operating data.

Obviously for the set to function, the total flow resistance of the piping plus catalytic equipment cannot exceed (62-43)=19 psi, the difference between pumping limit and corresponding turbine inlet pressure. In order to provide a margin of safety and to avoid overstressing a thrust bearing used in the set, design system pressure drops are held to about 8 psi, leaving a margin of 4 or 5 psi for unavoidable pressure drop increases during plant operations. Another consideration for keeping minimum system pressure drops is the desirability of minimizing power loss.

The curves of Fig. 2, applying to standard suction conditions and turbine inlet temperatures of about 800 F, clearly show that turbine inlet pressure is substantially non-variant at a given compressor suction condition, and this serves as the pressure datum of the regeneration (combustion) equipment. The pumping limit represents the maximum or ceiling pressure which can be developed by the compressor. The operating pressure at the discharge of the compressor is in no sense arbitrarily determined, as it equals the sum of the turbine inlet pressure plus the process-determined system pressure drop. The attempt frequently made to specify turbo units in terms of a fixed compressor discharge operating pressure and two or more delineated system pressure drops results in differing turbine inlet pressures purely fictitious and without significance in calculating power relations.

Seasonal Variations

The most fundamental characteristic of the turbo-compressors is the substantially constant suction volume of air pumped regardless of discharge pressure. As a necessary corollary it follows that the standard volume, cfm at 60 F atmospheric pressure, varies markedly with ambient air temperature, the effect being inversely proportional to the absolute temperature ratio. Changes in suction pressure caused by air filter pressure drop, operation at elevated sites and changes in the barometer exert an effect proportional to the absolute pressure ratio. On Figs 4 and 5 variations in flow resulting from air temperature changes are graphed, using as a basis 23,000 and 40,000 cfm suction volume, which is representative of many of the early units installed. Suction pressure has been taken as 14.4 psi absolute, corresponding to standard barometer and 9 inches of water air filter pressure drop.

In arriving at the corresponding turbine inlet pressures graphed on Fig. 5, use has been made of a derived approximate equation based on averaged characteristics of several machines. An inlet temperature of 800 F has been assumed.

$$P = aW\sqrt{\frac{T}{MW}} = \text{approximately } a'W\sqrt{T}$$

where:

P=Turbine inlet pressure...psi abs
a, a'=Constant depending on machine clearances, etc.
W=Flue gas flow rate...lbs/minute
T=Turbine inlet temperature..... ..... ° F+460
MW=Flue gas molecular weight.. ..... lbs/mol

Having established the weight flow rate and turbine inlet pressure at the various air inlet temperatures, the variation in the regeneration system pressure drop—or in any of its components—are obtained by a trial and error calculation involving an assumed average system pressure and the known or calculated pressure drops at one flow-pressure condition. The breakdown of the system pressure drop for the 40,000 cfm unit is shown on Fig 5. At any given air inlet temperature, the corresponding compressor discharge pressure is merely the sum of the turbine inlet and system pressure drop.

The power relations graphed on Fig 6 as functions of compressor inlet temperature have been calculated, using the previously determined pressures. Flue gas volume has been taken as 104 per cent of air volume, corresponding to average operation. The specific heat ratios or isentropic expansion exponents "n" used have been based on the data and method of averaging described in the literature.[9] Curves for net excess electrical power represent the difference between turbine output and compressor input corrected for auxiliary steam turbine windage, generator and gear losses. In terms of practical operating considerations, such as maximum auxiliary power demands and the extent of excess power production, the overall seasonal power swing is of interest. The swings shown on Fig 6 are based on air temperature fluctuations in a foreign installation which admittedly

(Continued on page 144)

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Seagram

(Continued from page 63)

Boiler feedwater is pumped to the boiler by Ingersoll-Rand CNT centrifugal boiler feed pumps, each of 375 gpm capacity at 1400 ft head. For the initial installation two pumps are being used, one driven by a 200 hp Westinghouse Co. 3500 rpm constant speed a-c motor, the second by a 177 hp Terry steam turbine. For the ultimate 3-boiler plant, a third steam-turbine-driven pump will be installed. Boiler feedwater level is regulated by a Bailey 3 element water level control system. A separate emergency boiler feed supply line with manually-operated control valves is also provided.

Boiler Feedwater and Process Water

For supplying distilled water to the Lawrenceburg distillery processes, a Permutit Company de-mineralizing system was installed. Well water flows to a Zeo-Karb H (hydrogen zeolite) softening unit, then to a deacidite unit where the mineral acids formed in the zeolite unit are removed. Finally, any carbon dioxide is removed by passing the water through a vacuum degasifier or decarbonator, whence it flows to the distilled water system of the plant.

For preparing boiler feedwater, a Permutit hot process lime-soda and phosphate softener followed by pressure filters is used, providing water heating and deaeration of the feedwater. The capacity of the hot-process unit is supplemented by a new Permutit Zeo-Carb H and Na softener with deaeration in the hot-process condensate section. Condensate returns from process and heating in the distillery are handled by Nash Engineering Co. condensate receivers and pumps and the boiler make-up is about 70 per cent.

In the Lawrenceburg plant, compressed air will be supplied at 100 psi for distillery processes by three Ingersoll-Rand 289 cfm single-stage carbon-ring air compressors driven by Louis Allis totally-enclosed, 75-hp, 1150-rpm motors.

Relay Plant Boilers

The boilers at Relay will be Babcock & Wilcox Co. units, of the same vertical bent-tube 4-drum type as those at Lawrenceburg but of smaller capacity. These Relay units will have a normal capacity of 75,000 lb per hr each, peak capacity 90,000 lb per hr each. Like the Lawrenceburg boilers, they will be designed for ultimate operation at 425 psi, 600 F but for the present will be operated at saturation temperature. As at Lawrenceburg, the initial installation at the Relay plant consists of one boiler, with suitable provision for three boilers in the ultimate plant and for installation of steam turbine generating units as justified. For the present, all electric power for this plant will be purchased from the local utility.

The first boiler at Relay has a completely water-cooled furnace, designed for a heat release value of 17,800 Btu per cu ft per hr. It will be fired by pulverized coal supplied by a single 11,300 lb per hour Raymond bowl mill, with provisions the same as at Lawrenceburg for oil firing. Flue gas from the Relay boiler will be supplied to the spray drier in essentially the same manner as at Lawrenceburg. This Relay boiler will be controlled by a Hagan combustion control system.

Coal handling system at Relay differs very little from that at Lawrenceburg. The equipment is to be built and installed by Beaumont Birch and consists of a flight conveyor from track hopper to crusher and continuous bucket elevator, with flight conveyor for bunker distribution. Figure 12 shows how a dust-collecting system is installed to withdraw dust-laden air from this conveyor, also from the pump room and the pulverizer space, by means of a Roto-clone dust collector.

Blaw Knox functional spring hangers and vibration eliminators used on piping.

Relay Plant Water Treatment

The water treatment system at Relay also differs in details from the Lawrenceburg system. For process water, the same general type of Permutit de-mineralizing system provides distilled water. A diagram of this system is shown in Fig. 14. For boiler feedwater, however, a Permutit Zeo-Carb Na softening system is employed, followed by deaeration in a deaerating heater as shown in Fig. 10.

Aside from such details the two initial boiler plants at Relay and Lawrenceburg are of fundamentally the same design, and both are integrated with the spray drying processes in the manner explained above. As the remodeling of each distillery proceeds, the power plants can be expanded as desired along the lines projected and there will be flexibility in the design to allow for any unexpected process developments. The increase in boiler efficiency as compared with that of operation of older boilers is a gain in fuel economy but equally important is reliability of steam supply.

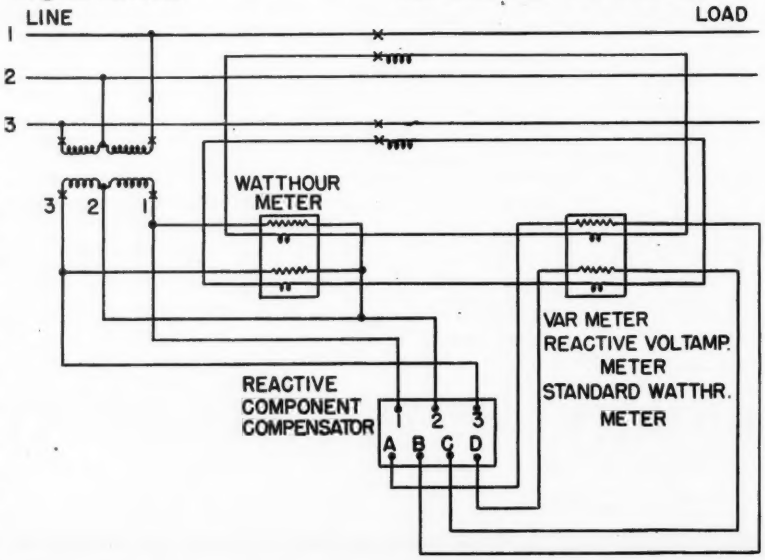
Acknowledgments

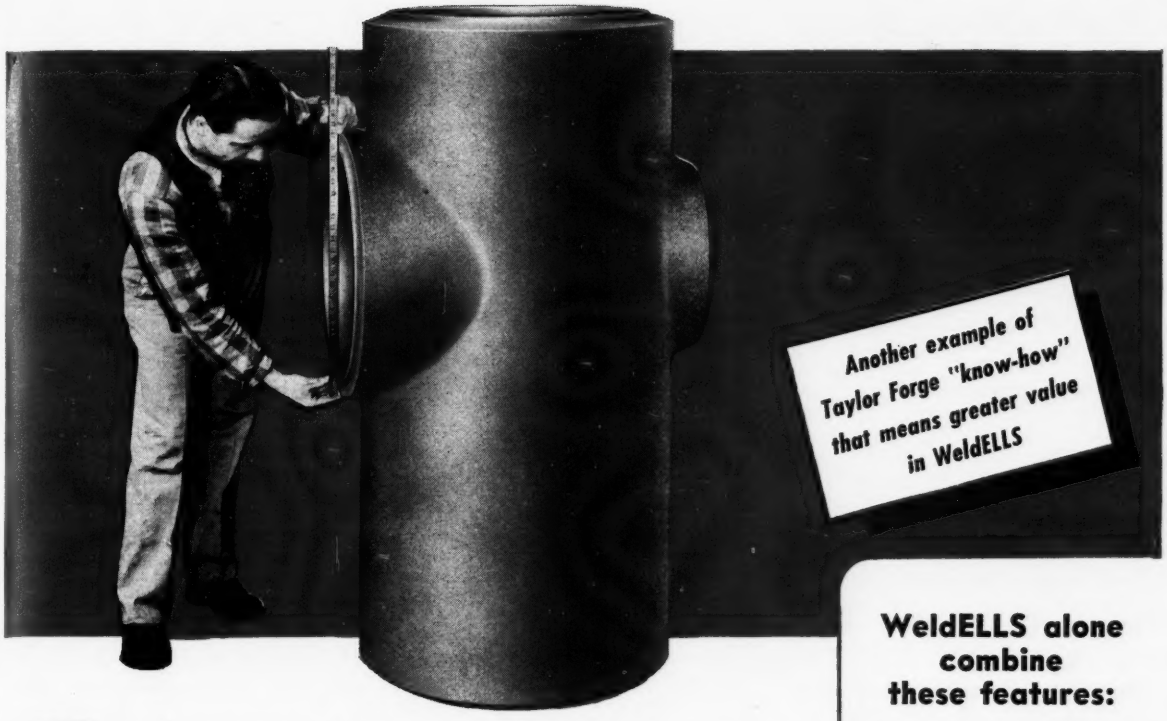
The two power plants described here have been designed by Smith, Hinchman & Grylls, Inc., architects and engineers, who are consultants on the entire project for remodeling and rearranging the Lawrenceburg and Relay distilleries, including the architectural design of the buildings as well as the design of piping, mechanical equipment and processes. We are indebted to H. L. Walton, president; B. C. Stewart, senior mechanical engineer and W. W. Aronwits, mechanical engineer in charge of design, all of Smith, Hinchman & Grylls, for their cordial co-operation in obtaining the above data. We are also indebted to H. Fred Wilkie, vice-president, J. A. Prochaska, assistant to the vice-president, W. M. Reindollar, director of engineering, all of Jos. E. Seagram & Sons, Inc., and to other officials of that company for their assistance in preparing this article.

Power Factor or Vars—Correction

A regrettable error occurred in C. O. von Dannenberg's article "Power Factor or Vars" which appeared in the September issue. The connections shown in Fig. 4 on page 102 are incorrectly drawn. They should be as shown in the corrected diagram herewith.

Attention is also directed to two other errors. On page 102, column 2, the decimal point was omitted from the 0.9 in the formula near the bottom of the page. This formula should read $100 \div 0.9 = 111.1$. On the same page, in column 3, the multiplying factor 0.866 is derived from the square root of three and the expression should read $\sqrt{3} \div 2$ or 0.866.





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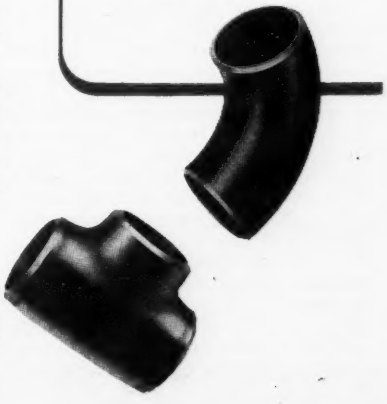
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking** — saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends** — provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.



WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

Application of Electric Motors to Power Station Auxiliaries

(continued from page 80)

and is not the main factor in determining the motor to be used. Where the pulverizers do not have a fan mounted on a shaft extension of the motor driving the pulverizer, but have a separate motor drive for the fan, it is recommended that motors for driving the pulverizer have at least 200 per cent starting torque. Where one motor drives the fan and pulverizer combined, motors having 200 per cent starting torque are frequently used. However, since when operating at full speed the fan requires approximately 40 per cent of the total load and the pulverizer 60 per cent of the total load, it is quite possible that a normal starting torque, normal starting current motor will have sufficient torque to start and drive the pulverizer successfully. On the other hand, if a motor having less than 200 per cent starting torque is used, the torque requirements of the pulverizer should be checked carefully with the starting torque developed by the motor. The motors for driving any of these pulverizers should have at least 200 per cent maximum running torque in order to operate successfully through serious voltage disturbances of short duration.

The pulverizers known as table mills do not have a high effective WR^2 at the motor shaft, although the moving parts are heavy. These pulverizers have a high break-away torque requirement, and the motors for driving them should have at least 200 per cent starting torque in order to start the pulverizers and bring them up to speed successfully under normal operating conditions. In addition, they should have at least 200 per cent maximum running torque in order to operate successfully through voltage disturbances of short duration. Also, as indicated previously, the overload relays used with high torque motors should be of the type which disconnect the motor quickly if it stalls.

Modern coal pulverizers and associated coal handling equipment are usually dust-tight. Therefore little dust from the coal pulverizers reaches the driving motors and the degree of protection is frequently determined by factors other than the pulverizer itself. Often the degree of enclosure required to protect the driving motor depends on the surrounding conditions rather than on the fact that the motor is driving a pulverizer. Therefore, the comments made previously regarding motor enclosures will apply to motors for pulverizer drives. Drip-proof motors, shown in Fig. 7, are sufficiently protected for a large percentage of the pulverizer applications. If, however, the ambient conditions are such as to require additional protection it should be supplied, since the ambient condition rather than the equipment which the motor is driving determines the degree of enclosure required by the motors.

Regardless of the degree of enclosure provided, motors for driving pulverizers should be rated 40 C rise, as it is usually quite easy to overload a pulverizer and its driving motor. Therefore, the motor should have the usual service factor. If the ambient temperature is high, that is, above 40 C a fair portion of the hours in a year, class B insulation may be used to good advantage.

(To be continued)

The Effect of the Atomic Bomb on Our Civilization

(Continued from page 88)

in which they would be ready to fire them at us would not be materially shortened. We should then seek to enter into international agreement, renouncing the bomb as an instrument of warfare and providing for international inspection of mines, laboratories and plants."

No one can afford to question the wisdom of Dr. Hutchins' appraisal of the situation and yet there seems to be little chance that his proposal can be brought to even a moderate degree of realization. Despite the war and lofty resolutions the world is still full of fear and mistrust. All of the agreements that might be made by the United Nations Organization would be of no value if the world is determined to have another war. Unless there is good will, good faith among the nations, unless they are willing to share their advantages and render mutual assistance, all formal agreements are worthless. It will be seen then that the issues before us are social and moral rather than technical. Technical developments will continue regardless, but unless our social and moral and continued development increases enormously and quickly, our technical development will end only in our destruction.

Even as this is being written the newspapers are full of absurd and childish statements concerning the secrecy of the atomic bomb. Secretary of State Byrnes assures us that the secret of the bomb is safe with us. Senator McMahon who is chairman of the special committee on atomic investigation and who obviously knows nothing of nuclear physics recommends the appointment of a jury of civilians to evaluate the forthcoming naval tests of the atomic bomb.

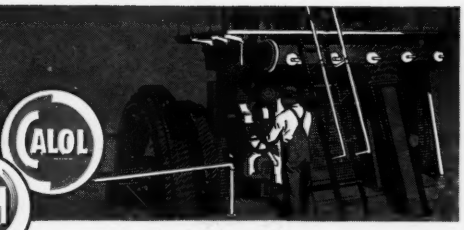
At the same time it is disclosed that the naval tests are being planned and will be carried out without the active participation of any of the scientists who directed the New Mexico tests and the bombings of Japan. The Federation of Atomic Scientists assailed the President's plan to place civilians in charge of the tests as a worthless gesture in an already "silly" and "meaningless" plan. Dr. Albert S. Cahn, University of Chicago physicist and spokesman for the federation said, "We already know that the test isn't worth much. Not many boats will be sunk. This isn't a test of atomic power. This is a demonstration of power by the Navy . . . so that the Navy will get bigger appropriations. . . . The danger is that as a result of this test the people will think we are safe from atomic attack. Actually this isn't so."

There has been some criticism regarding the reports of the effect of the atomic bomb. Major Alexander P. deSeversky claims that the damage at Hiroshima and Nagasaki by the atom bomb was over-estimated; that both of the Japanese cities were made up mostly of wooden shacks, poorly constructed and so were easily destroyed. Similar bombs dropped on New York or Chicago, he claims, would have done no more damage than a ten ton block-buster, and the results in Hiroshima and Nagasaki could have been achieved by about 200 B-29s loaded with incendiaries.

There may be considerable truth in Major deSeversky's assertion but it must be remembered that he is only referring to the two bombs that actually fell, not on the effect of what future bombs we may make. It is quite possible that the effect of the two bombs would have been different if dropped on modern cities, but the fact still remains that these single explosions were so far beyond anything ever achieved before that even if the damage was not as great as it has been claimed to be it still is far in access of anything we knew before. How much fissionable material was in the atom bomb has not been disclosed and it is anybody's guess. The War Department says it was something between 2 pounds and 200 pounds. It probably was closer to the smaller figure than the larger one and most guesses seem to run from 8 to 20 or 30 pounds. If such small amounts were actually used it is not difficult to form an idea of what future bombs may be like. It must be remembered also that in the fission of uranium as it takes place in the atomic bomb, only a small fraction of the total energy in the atom was released. Suppose then that in the future we learn how to blow the uranium nucleus not in half but into many small fragments it is clear that explosions far beyond anything at Hiroshima or Nagasaki would occur even with the same amount of material.

In commenting on Major deSeversky's claim, Chicago scientists reminded him that the bombs dropped on Japan were the first atomic bombs ever made, that they were firecrackers compared with what will be developed in ten or twenty years.

STANDARD ENGINEERS NOTEBOOK

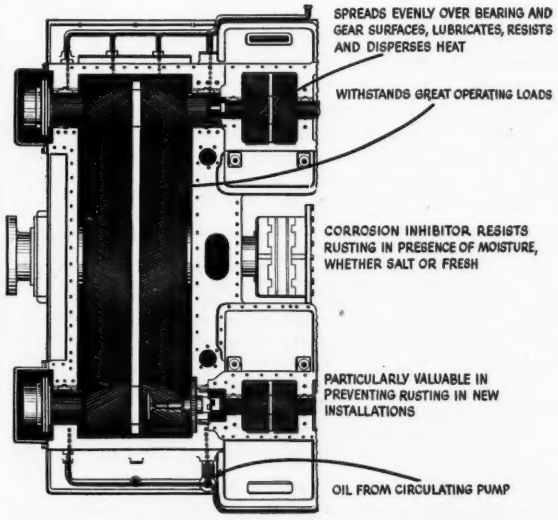


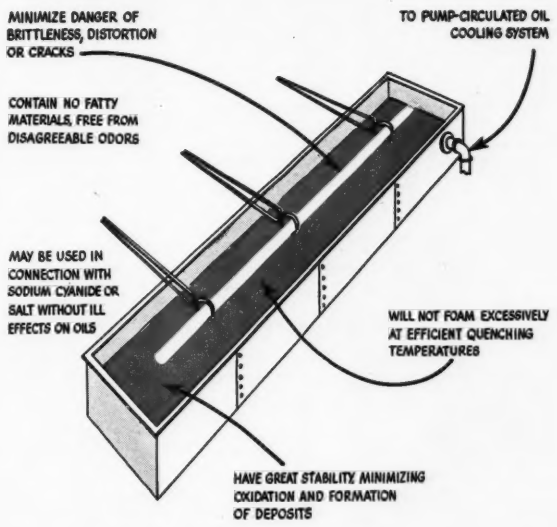
Inhibited turbine oils prevent rust damage

The usual danger of rusting when new installations of double reduction steam turbines are first charged can be eliminated by using Calol OC Turbine Oil 19. It will also give turbine and gears full protection throughout their lives.

Calol OC Turbine Oil 19 is a compounded oil, made from selected crudes. It contains a highly effective rust inhibitor which protects against both fresh and salt water. In official tests, steel strips immersed in mixtures of Calol OC Turbine Oil 19, fresh water and synthetic sea water showed no sign of rusting after 48 hours. Calol OC Turbine Oil 19 also contains an efficient oxidation inhibitor.

The high film strength of Calol OC Turbine Oil 19 provides a wear-reducing cushion that carries the heavy weight imposed on turbine bearings. Minimum wear prevents rotor misalignment trouble. Calol OC Turbine Oil 19 is non-corrosive and separates rapidly from water with little sludge formation.


SPREADS EVENLY OVER BEARING AND GEAR SURFACES, LUBRICATES, RESISTS AND DISPERSES HEAT
WITHSTANDS GREAT OPERATING LOADS
CORROSION INHIBITOR RESISTS RUSTING IN PRESENCE OF MOISTURE, WHETHER SALT OR FRESH
PARTICULARLY VALUABLE IN PREVENTING RUSTING IN NEW INSTALLATIONS
OIL FROM CIRCULATING PUMP


MINIMIZE DANGER OF BRITTLENESS, DISTORTION OR CRACKS
TO PUMP-CIRCULATED OIL COOLING SYSTEM
CONTAIN NO FATTY MATERIALS, FREE FROM DISAGREEABLE ODORS
MAY BE USED IN CONNECTION WITH SODIUM CYANIDE OR SALT WITHOUT ILL EFFECTS ON OILS
WILL NOT FOAM EXCESSIVELY AT EFFICIENT QUENCHING TEMPERATURES
HAVE GREAT STABILITY MINIMIZING OXIDATION AND FORMATION OF DEPOSITS

Stable oils produce uniform hardness in steel

Because they retain their original viscosities in continued use, Calol Quenching Oils maintain a constant quenching speed and produce uniform hardness in steels. They have a high resistance to oxidation and contain no fatty oils to produce disagreeable vapors.

Calol Alloy Quenching Oil consistently and quickly produces higher hardness in alloy steels. Its unusual cooling power is based on what is believed a new principle. Unlike water, it eliminates the chance of brittleness, distortion or cracks.

Calol Quenching Oil is recommended for high-carbon steels. Made from selected mineral oils covering a wide boiling range, it provides the moderate cooling-rate desirable for these steels.

For suggestions on the use of Calol Quenching Oils, information about machining various metals and the lubricants required, write for the free booklet: "Calol Cutting Fluids."

For additional information and the name of your nearest Distributor, write Standard of California, 225 Bush Street, San Francisco 20, Calif., or The California Oil Company, 30 Rockefeller Plaza, New York 20, N. Y.

FOR EVERY JOB A **STANDARD OF CALIFORNIA** TEST-PROVED PRODUCT

NEW EQUIPMENT

Information that you desire about any equipment will be gladly furnished without obligation. Write to POWER PLANT ENGINEERING 53 W. Jackson Blvd., Chicago 4, Ill.

Strainer With Removable Basket

A. "Y" STRAINER the product of J. A. Zurn Mfg. Co., Erie, Pa., has been designed with a snug fitting strainer sleeve unit to assure trouble free operation. This strainer sleeve is removable but it is so designed that it cannot get out of place or vibrate when in use. This enables the unit to be installed in almost any position on a pipeline. When service conditions require it, the strainer basket is magnetized for intercepting metal

particles that are extremely ruinous to valve seats and vital parts of operating pipeline equipment.

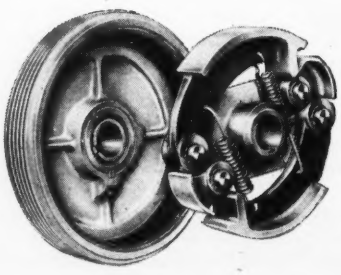
All units are hydrostatically tested according to the service pressures under which they will be required to operate. They are available with or without a cleanout plug, or can be furnished with a threaded blowoff connection.

This "Y" strainer is manufactured in cast bronze, steel, semi-steel or cast iron, depending upon the conditions to which it is subjected. A wide range of sizes is available for flanged, welded or threaded connections.

Automatic Clutch

SALISBURY AUTOMATIC CLUTCH is a device which works on the principle of centrifugal action and progressively applies the power to the driven machinery. It has recently been developed by Salsbury Motors, Inc., 4464 District Boulevard, Los Angeles 11, Calif. The device was designed to engage and disengage without human control in order to eliminate the sudden shock of starting machinery or moving equipment. In the power field its use is suggested for gas and Diesel engines.

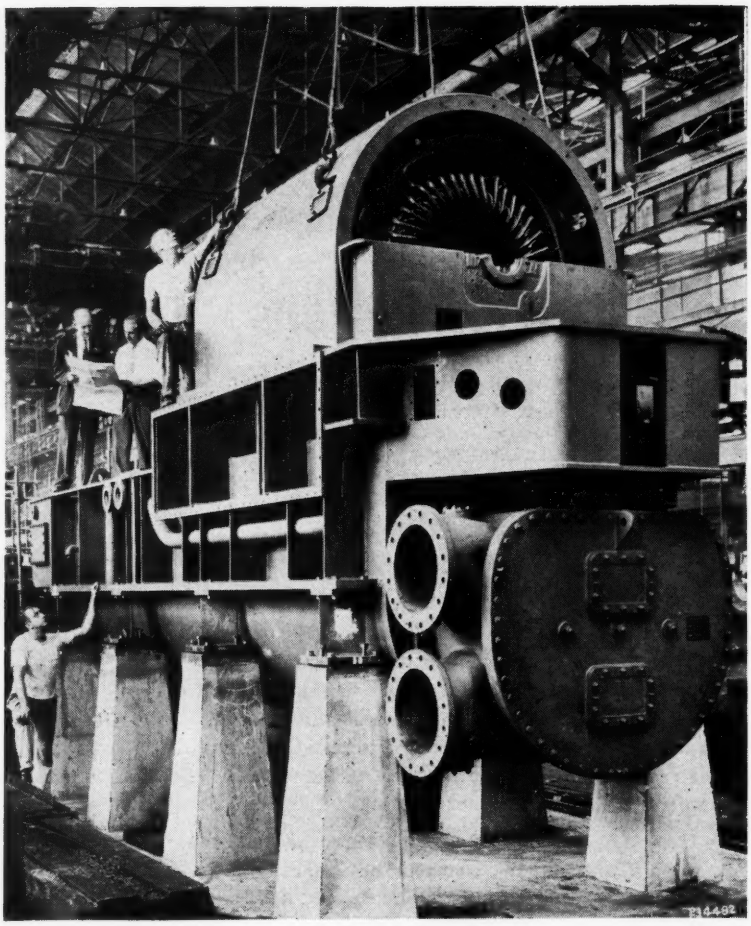
In construction the clutch is an opposed shoe type, dual-spring balanced, to give the desired degree of tension required for individual applications. Below a predetermined rpm of an engine or motor, the clutch idles; when the driving rpm increases beyond the stipulated rpm the expansion shoes press outwardly, contacting the friction lining of the drum, thus engaging the driving with the driven shaft.



Two models of this clutch are available—one for the range from fractional to 3 hp and one for up to 6 hp. Different drives can be mounted on the shaft—V-belt or flat belt pulley, gear, sprocket, coupling, or a variable speed transmission. The 3 hp model has a drum diameter of 5¼-in. and length of 2 11/16-in.; the 6 hp model has a drum diameter of 7¼-in. and length of 4½-in.

Vibro-Levelers

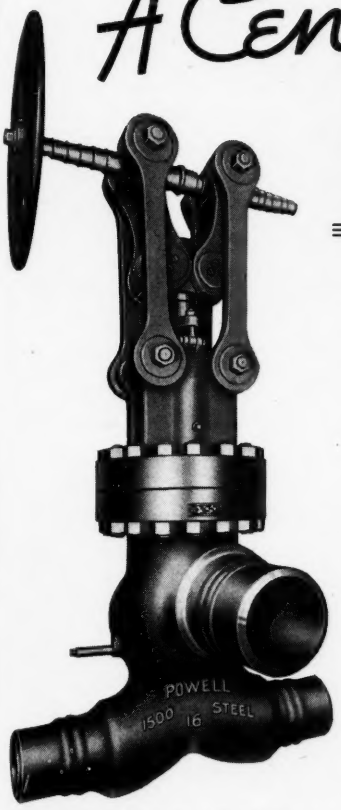
RUBBER INSULATED dual purpose machinery mountings for stopping vibration from machinery of any size, type, or weight and having a means of leveling the machinery is announced by Bushings, Inc., Coolidge Highway at 14 Mile Road, Royal Oak, Mich. Vibro-Levelers, as these new mountings are called, are manufac-



Package Power Plant

THIS 5000-kw power-generating unit which includes steam turbine, condenser, and auxiliaries, is complete as one unit having been developed by Westinghouse and intended for installation abroad where small, ready-designed power plants requiring the minimum of erection time, skill, and preparation are needed. The unit is essentially a combination of standard, thoroughly tried power units designed specifically for maximum compactness and simplicity. The condenser serves as the foundation superstructure and upon it rests the turbine, the generator, and auxiliaries. The plant is designed to operate at 600 psi, 825 F total temperature and 28-in. vacuum, and the entire plant occupies a floor area of 31 by 13 ft and stands 17½ ft high.

A Century of Progress in making valves for Power Plants



Class 1500-pound Cast Steel, Toggle Operated Non-return Angle Valve with welding ends. Has 16" outlet and two 12" inlets. Because of special streamline designing, the pressure drop through the valve is minimized.

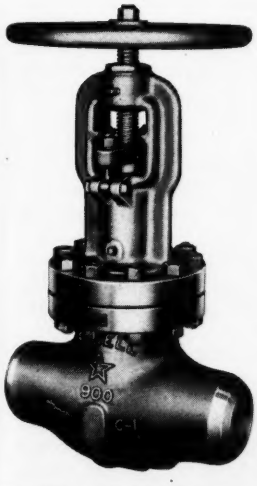
FOR 100 YEARS, Powell has concentrated on making valves—and valves only—to meet the ever-changing demands imposed by the amazing progress of American Industry. Thus, through the years, Powell Engineering has been consistently keeping pace with the vast progress in the power field and today Powell has a correct valve for every service in this all-important branch of industry.

The Powell Line of Bronze and Iron Valves of all types for handling intermediate pressures offers the widest possible selection. And, to meet the modern trend toward high pressure installations, Powell presents a remarkably complete line of Cast Steel Valves for pressures from 150 to 2500 pounds. Powell Cast Steel Non-return Valves, available with spur or bevel gear, toggle or motor operation, afford maximum protection for boiler installations. Catalogs on request.

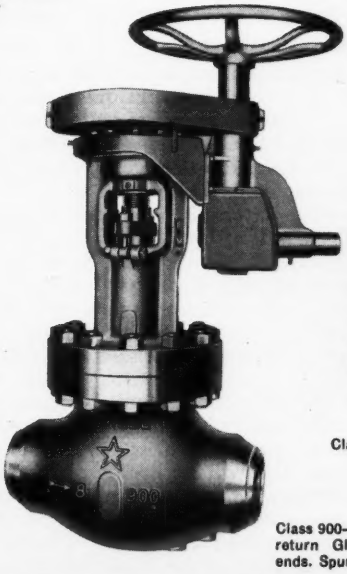
The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

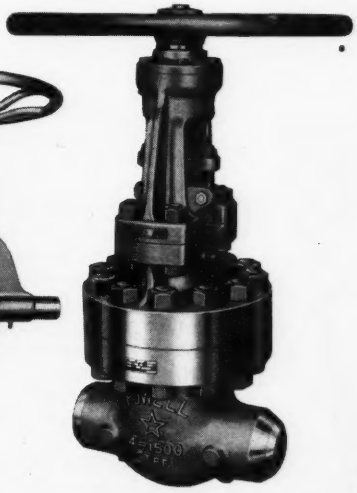
Class 900-pound, 10" Cast Steel Non-return Angle Valve with welding ends. Spur gear operated.



Class 900-pound Cast Steel Welding End O. S. & Y. Globe Valve.



Class 900-pound, 8" Cast Steel Non-return Globe Valve with welding ends. Spur gear operated.



Class 1500-pound Cast Steel Welding End O. S. & Y. Gate Valve.

Class 900-pound Cast Steel Gate Valve with welding ends, welded bonnet and special by-pass. Bevel gear operated.

POWELL VALVES

tured in nine sizes ranging in load capacities of from 10 to 2000 lb each and are for use on such noise and vibration producing equipment as punch presses, compressors, blowers, forging hammers, grinders, buffers, etc. The mountings are readily installed on either new or existing equipment and brackets are made available to permit installation of mountings without materially raising the elevation of the machine. These mountings are made of synthetic rubber. The insulating material employed is not liable to attack by oils or greases and thus can be used under virtually any conditions. The rubber insulating material separates an outer shell which also forms the base of the mounting, from an inner cylindrical member, to which is fastened a single stud.

Leveling is accomplished by means of two nuts supplied with each mounting; one nut is for adjusting the machine to the exact level desired; and the other for locking in the leveled position.

Flow-Type Conductivity Cell

A NEW POSITIVE-FLOW type cell has been developed by Industrial Instruments, Inc., 17 Pollack Ave., Jersey City, N. J., for use with its electrolytic conductivity controllers and recorders. Compact, and enclosed in a hinged steel case, the unit consists basically of a tubular glass conductivity cell with concentric cylindrical platinum electrodes, and a continuous duty stainless steel centrifugal pump. The unit is adapted for mounting either on the outside wall of a tank, or on an instrument panel at a distance from the tank. Connection to

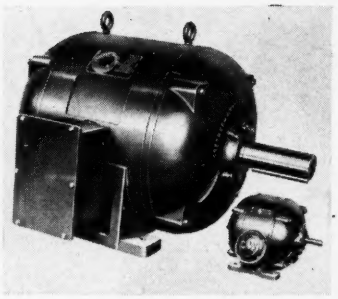
the liquid under test is made with ⅜-in. o.d. Saron or metal tubing.

With this type of conductivity cell, accurate measurements can be made even with rapidly changing concentrations since the forced circulation reduces the time lag to a very small value. Another important advantage of this design is that it permits the use of a cell of high cell constant where the liquid is a good conductor. This is necessary in making accurate measurements in highly conductive solutions.

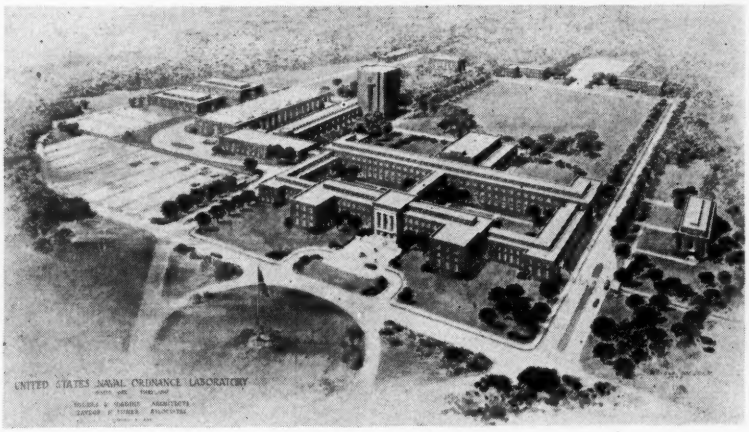
Since the only part that must be immersed in the liquid is a short length of small gage metal or plastic tubing, the problem of breakage of cells by moving parts in the tank itself is eliminated. In conjunction with several small valves, a single Type-J Flow cell can be used to maintain a check on the contents of a number of tanks.

Protected-Type Motors

CROCKER-WHEELER, Division of Joshua Hendry Iron Works, of Ampere, N. J., now offers a complete line of alternating-current, squirrel-cage, Protected Type Motors from 1 to 200 hp. This has been accomplished with the addition of three new frame sizes, designated as B58-A, B and C. These motors are priced the same as the conventional open type and are rated 40 C rise, full-load continuous duty, with a 15 per cent service factor. The motors are fully protected against dripping liquids, falling metal chips and other foreign matter.



On all ball bearing machines, the company's patented centrifugal bearing seal is used. This seal permits the

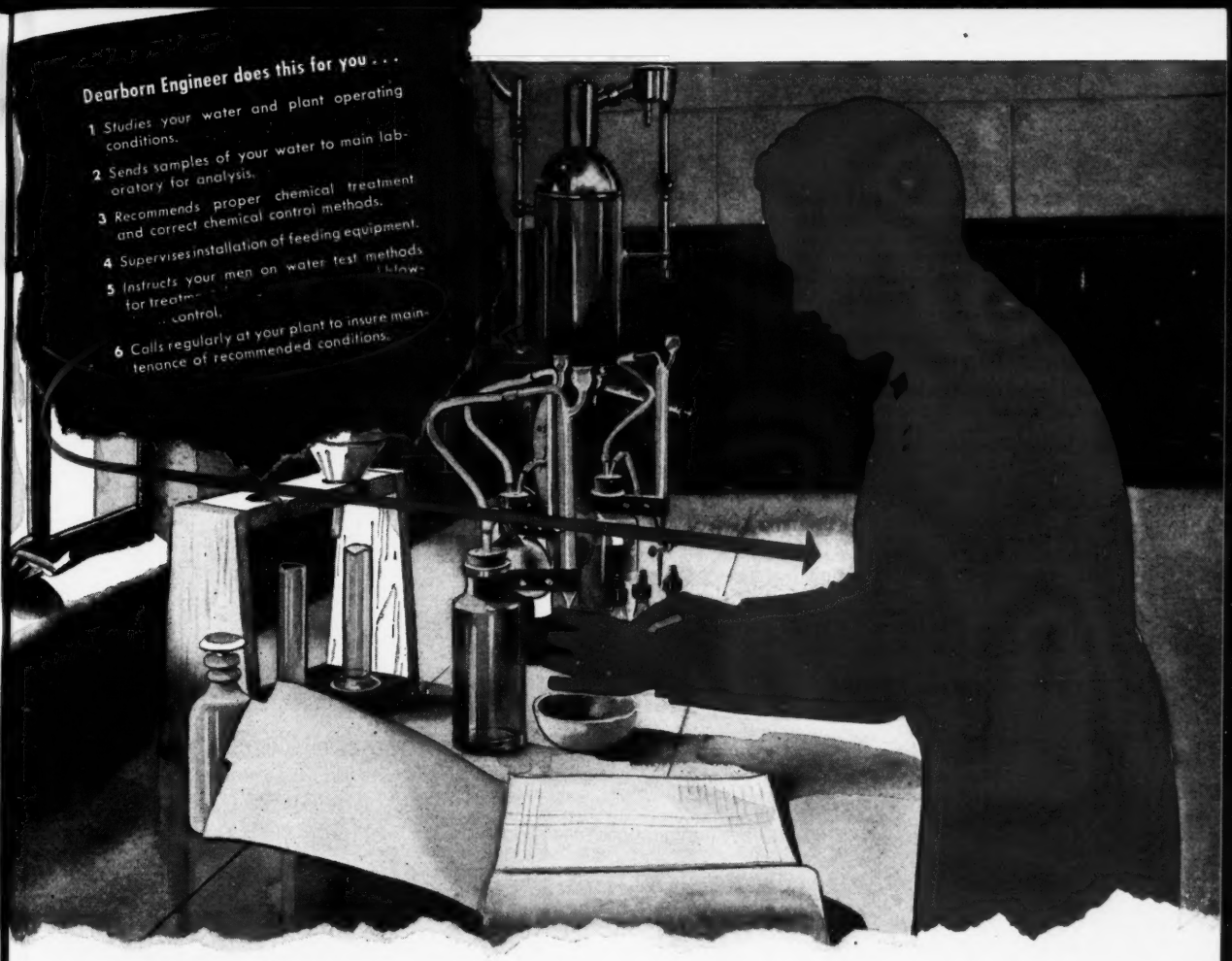


Naval Ordnance Laboratory

PRELIMINARY WORK in the preparation for the construction of the new Naval Ordnance Laboratory which will be located at White Oak, Md., has been begun by the contractor Charles H. Tompkins Co., of Washington, D. C. This company will construct a group of structures which will include the administration building, the photographic laboratory, spherical field laboratory, long field laboratory, officers' quarters, Marine barracks, and a portion of the roads which will connect the numerous units in the 938-acre area at White Oak.

Altogether there will be 50 permanent buildings built for the research center which the Naval Ordnance Laboratory will use for the peacetime continuance of scientific experiments in connection with underwater ordnance. Among the structures will be a $300,000 boiler plant which will supply steam for heating and for process work in the main laboratory. The cost of the entire project will be approximately $15,000,000.

Among the unusual features will be the magnetic buildings in the Quiet Laboratory, which has no electric lights, water pipes, or other ordinary facilities which could in any possible way interfere with the work of the men who will be probing into the mysteries of magnetic weapons and counter-weapons. Another building has a temperature control room for producing immediate temperature variations of between minus 80 and plus 180 F. In the accompanying illustration which is an architects drawing of the main buildings it will be seen that the administration building is on either side of the entrance while the space in the outer wings and in the long building in the rear is to be devoted to the general laboratory. Directly ahead of the large tank is the mechanical test building. Shops will be in the long building with the saw-tooth roof and on the extreme left are warehouses. In the background are a firehouse and garage, power plant and barracks. At the extreme right is the building where experiments on ammunition will be conducted.


Dearborn Engineer does this for you . . .
1 Studies your water and plant operating conditions.
2 Sends samples of your water to main laboratory for analysis.
3 Recommends proper chemical treatment and correct chemical control methods.
4 Supervises installation of feeding equipment.
5 Instructs your men on water test methods for treatment control.
6 Calls regularly at your plant to insure maintenance of recommended conditions.

. . . IT'S THE Continuing Service

THAT NIPS WATER TROUBLE IN THE BUD

When trouble due to water conditions raises its head, Dearborn treatment applied under the skilled direction of Dearborn Engineer nips it in the bud.

Service does not stop with the first treatment application. Dearborn Engineer calls regularly to assist with maintenance of the balanced treatment program.

The type and amount of reagents required to properly condition your boiler water have been previously determined by a study of your plant operating conditions, water analyses, and final formulations by Dearborn laboratories.

Keeping boilers in good physical trim is naturally under the watchful eyes of *your own* men. When Dearborn Engineer co-operates with them . . . month after month . . . you're doubly assured of top steaming efficiency.

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TRADE MARK REGIST

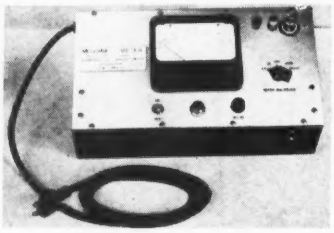
THE LEADER FOR OVER HALF A CENTURY
ENGINEERING SERVICE AND WATER TREATMENT

use of softer grease for better lubrication and longer bearing life.

Rotors are Alucast, a term used to describe a construction in which the bars, fans and end rings are cast in one operation from aluminum alloys. This construction is employed for sizes 203 to 404 inclusive. Rotors of larger sizes have copper bars with brazed on fans and end rings. Stator coils of all sizes are protected by Vinylastic insulation.

Megohm Meter

AMONG THE OUTSTANDING features of the new model 1500 megohm meter developed by the Communication Measurements Laboratory, 120 Greenwich Street, New York 6, N. Y., are the unusual stability, portability, and a range from 400,000 ohms to 100,000 megohms in five ranges on single scale four inch meter. It is reported that the instrument is so designed as to protect it against atmospheric conditions where precise testing is required. Its accuracy is said to be within 5 per cent at any position on all ranges. Model 1500,

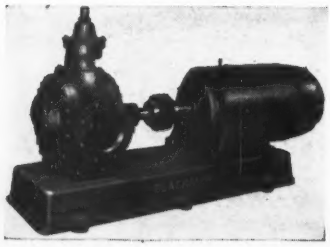


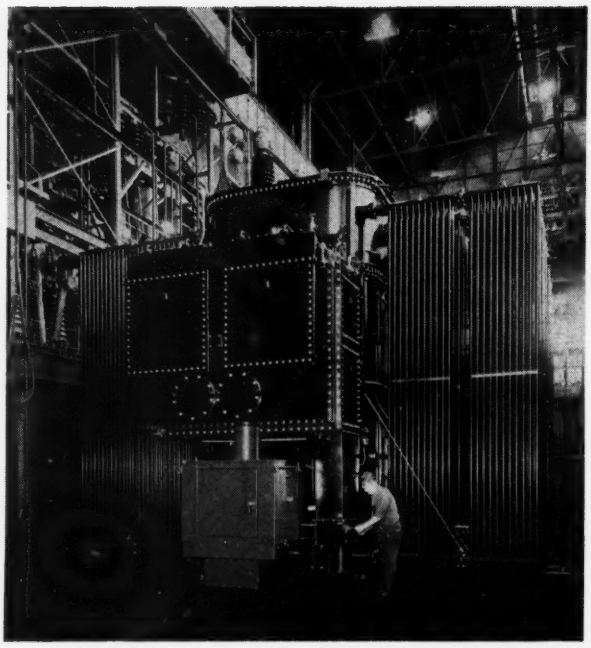
which weighs only 8 lb, may be employed in laboratories or on production lines where it is necessary to measure and test in widely scattered locations. Applications include the measuring of leakage, resistance of insulation materials, condensers, coaxial cables, wiring harness, motor and transformer windings. The unit is also recommended for determination of moisture content of wood, paper board, plastics, textiles, and many other materials in which electrical resistance is a function of moisture content.

Fuel-Oil Pump

FOR HANDLING BUNKER *"C"* fuel oil and liquids of similar characteristics a new special rotary pumping unit has been put into production by the Blackmer Pump Co., Grand Rapids, Mich.

The pump is bronze-fitted and operates on the bucket design (swinging vane) principle. Due to this construction, the pump is self-adjusting for wear, so that there is no loss of capacity during the life of the buckets.





Giant Size Transformers Completed

COMPLETION OF the first of two, three-phase, 50,000 kva power transformers, built for use in one of the generating stations of a large eastern seaboard utility, has been announced by the General Electric's transformer division, Pittsfield, Mass. It will supply power to the utility's system serving shipbuilding, chemical, and other industries. One of the largest transformers built by General Electric in recent years, it measures approximately 33 by 22 by 23 ft and weighs 452,000 lb, including the 21,000 gal of oil which it holds. It is rate 60-cycle, 37,500-kva self-cooled, 50,000-kva forced-air-cooled, 110,000 high-voltage to 14,000 low-voltage. The unit, which has 34 radiators and 20 high-velocity cooling fans, required nearly 800 brazed internal connections in its construction. It has many controls required to handle the varying conditions of the load. Two unusual load-ratio-control equipments permit 33-in phase and 73 quadrature positions for changing voltage ratio to control the flow of power and reactive kva over high-tension lines. Because of the wide range of these controls, the transformer has the equivalent size of an 86,000-kva unit.

When worn to the critical point the buckets may be replaced by removing the head of the pump, pulling out the worn buckets and inserting new ones. This replacement restores the pump to normal capacity.

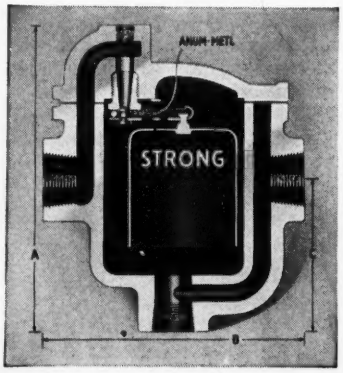
The power unit is a gearhead motor of 50 hp with a speed of 150 rpm at the drive shaft connected to the pump by a flexible coupling. The pump has a capacity of 500 gpm and operates at a pressure of 125 psi.

Silicone Oils

GENERAL ELECTRIC Co., Research Laboratory in Schenectady has announced the development of Silicone Oils that flow at temperatures as low as 121 degrees below zero Fahrenheit. These oils, prepared with methyl silicone polymers, will be useful as hydraulic fluids for aircraft systems in the operation of flaps, doors, and landing wheels, according to Dr. Rochow, who recently made the announcement before the Rochester, New York, Section of the American Chemical Society. Silicone oils also can be used in fine instruments, in watches and clocks, and as a dielectric fluid in capacitors and transformers. These oils have flow points as low as minus 121 F and may be used at plus 302 F without oxidation or sludging, their most unusual property being their small change of viscosity with temperature.

New Inverted Bucket Trap

ANNOUNCEMENT HAS COME from Strong, Carlisle & Hammond Co., 1392 West 3rd St., Cleveland 13, Ohio, that it has recently developed a



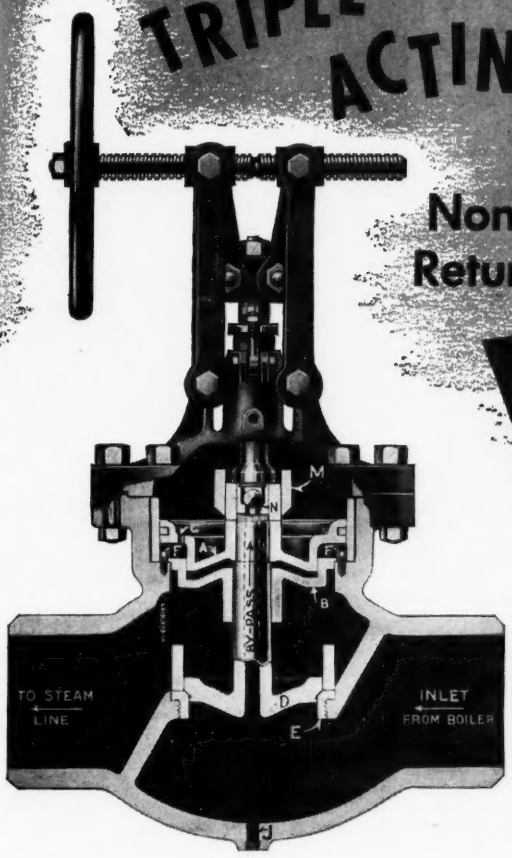
GOLDEN-ANDERSON

TRIPLE ACTING Non-Return VALVES

for

Engineered Protection

1. Will automatically cut in a boiler when its pressure equals line-header pressure.
2. Will automatically isolate a boiler whenever its pressure, from any cause, is lower than line-header pressure.
3. Will prevent steam flow from boiler in event of sudden drop in line-header pressure below the boiler pressure.



For maximum flexibility, safety and precision accuracy, put Golden-Anderson Triple Acting Valves in your boiler room.

- Prevents banging, chatter or spinning under any flow condition.
- All moving parts are in constant, perfect alignment.
- Built double extra heavy to prevent distortion or warping under pipe line stress and strain.
- Unfailing automatic operation for absolute safety.
- Available in bronze, monel, stainless steel or Gavalloy.
- Angle, Globe or Elbow patterns; sizes 2½" to 12" and larger sizes in the Cross pattern.

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Engineers

Work with you now, on any new or replacement problem involving high pressure flow control. Write for descriptive, technical catalog.

write for descriptive technical catalog

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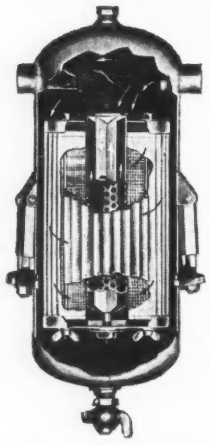
VALVE **Specialty Company**

FULTON BUILDING • PITTSBURGH 22, PA.

new series of strong industrial steam traps of the inverted bucket type. The features included in the design of this new trap are a scientfically designed orifice throat which gives up to 25 per cent greater capacity, avoids turbulence, and minimizes choking caused by flash steam. The trap has a screwed in valve seat which is renewable for easy servicing and a new design of lever construction gives quick, full opening without dribbling. In order to place the trap below the inlet pipe at all times, the straight through inlet-outlet connections have been relocated. These traps are available in 3 body sizes up to 1¼ in. in both standard and thermal design.

Liquid Filter

STAYNEW MODEL ELS Filters recently announced by Dollinger Corp., Rochester 3, N. Y., feature an entirely new and superior design of filter insert. Insert assembly consists of inner and outer radial finned forms of wire cloth. The outer form, on which the filtering medium is crimped, slips over



the inner form. Top and bottom plates and seal gaskets are then applied and the whole assembly held in place by through bolts.

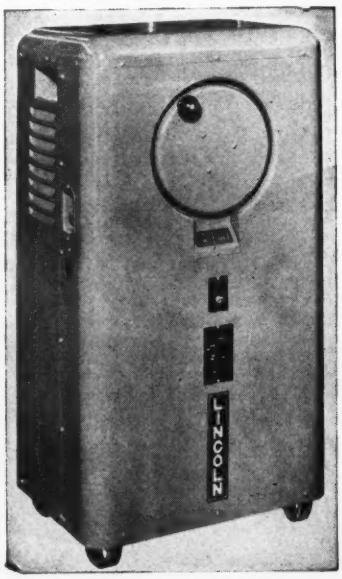
The new type insert, known as the Slip-On, permits the use of practically any type of filtering medium obtainable in sheet form that can be crimped. It also permits quick change or replacement of filtering medium in the field. Spare insert outer forms are relatively inexpensive and may be stocked in a variety of media ready for instant change or replacement.

Welder for 230 V, A-C

A NEW WELDER UNIT, called the "Fleet-Arc Jr.," has been announced by The Lincoln Electric Co., Cleveland, Ohio. It is for 230 v, single phase power lines and meets the limited input requirements of rural utilities and REA by a design of high efficiency and high power factor. It has a maximum input current of 35 amp and provides a machine which meets the new NEMA standards for this type of welder. It can be used with the standard 3 kva power transformer provided by the power company. Current range is from 20 amp at 20 v to 180 amp at 25 v welding duty. This gives sufficient capacity for all types of jobs found on most farms or job welding shops. It will handle electrodes ranging from 1/16 to 5/32 in. diameter.

"Fleet-Arc Jr." which simplified welding and multiplies its utility for repair and fabricating jobs done by average mechanics, inaugurates a revolutionary development known as the "Arc Booster" which provides quick, easy arc starting. The instant the electrode touches the work, the welding current is given a boost of intensity for starting the arc.

Current then reverts automatically to the amount set for the job. No high voltages or special high frequency devices are used, the output voltage being limited to a maximum of 52 v.



Either of the two degrees of arc boosting provided is selected by a snap switch, one for general work and the other lower amount for thin material. Current control for the new unit is of the separate adjustable reactance type which is varied by turning a hand wheel. Adjustment is continuous over entire welder range of from 20 to 180 amp.

Design and construction features of the new welder include: Wear-free and vibrationless reactor current control with self-cleaning chain drive. Heavy copper winding with spun glass insulation and mica coil separators. Arc welded steel frame and housing. Weight, 360 lb, makes the unit readily portable.

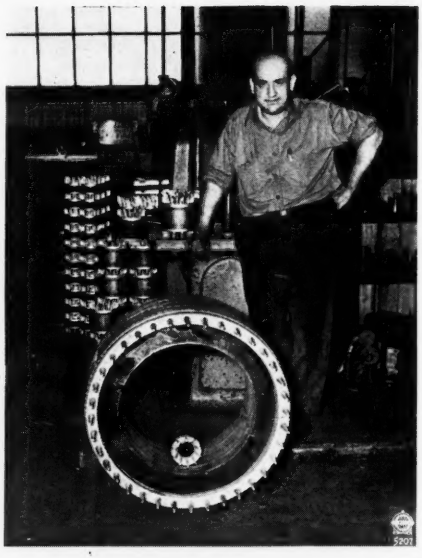
Hand Tachometer

A NEW DESIGN of precision hand tachometers to enable engineers to accurately read the revolutions per minute of any revolving equipment has been announced by George Scherr Co., 200 Lafayette Street, New York 12, New York. Scherr Tachometers operate on the centrifugal principle. The new models have five speed ranges covering an extremely wide range of speeds.

To change speeds, Scherr provides a knurled ring for speedy shifting. The four models provide for speed ranges from 30 to 48,000 rpm. It is thus possible to obtain the speed of generators, combustion engines, belts, elevators, transmission pulleys, power plants, textile machines, pumps, lathes, and other industrial machines.

These tachometers are said to gain their extreme precision from the fact

World's Largest Aluminum Rotor



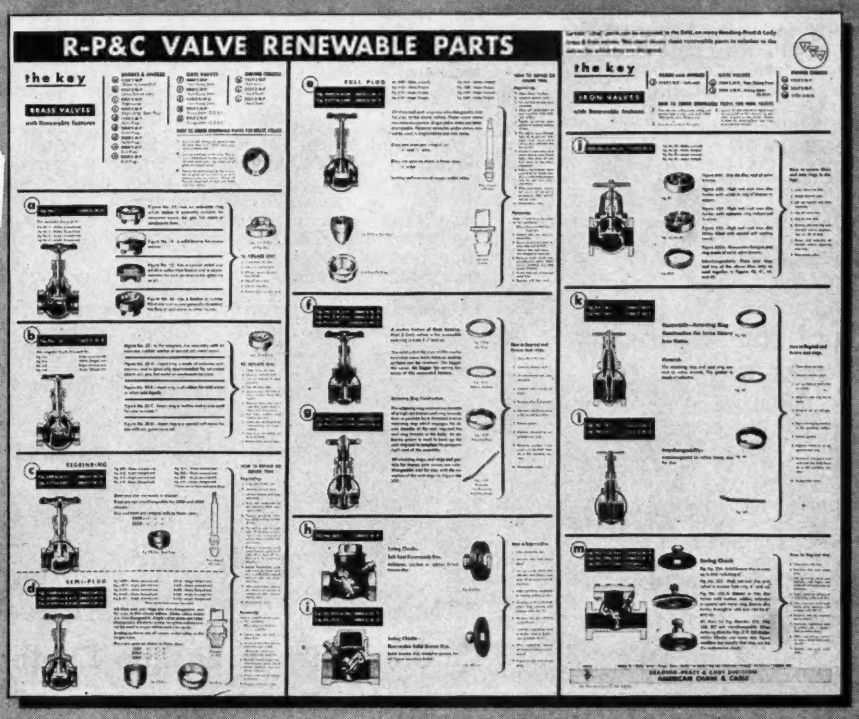
In the process of designing and building some special motors for the new body presses of an automobile manufacturer, engineers of the Reliance Electric & Engineering Co., Cleveland, Ohio, have recently perfected the pressure-casting of what are believed to be the largest aluminum rotors in the world.

The pressure-casting process employed makes a one-piece assembly of rotor laminations and cast aluminum windings, providing exceptional ruggedness. Until the special automotive press motors were ordered last spring, however, there had been no attempt to pressure-cast the rotating member of motors of large size.

Peter Voloshen, who has been with Reliance for 10 years and is now die casting supervisor, is shown with two sizes of pressure-cast aluminum rotors: a 5¼ in. rotor, used in a 1½ hp, 1800 rpm motor and the new 30 in. rotor which will go in special-purpose 250 hp, 360 rpm motors for the new automotive presses.

To Get Longer, Better Service from Valves

use this chart



Here is detailed, step-by-step instruction for renewing parts in all R-P&C globe, angle, gate and swing check valves which have renewable parts. Send for your free copy of this chart.

READING-PRATT & CADY

With distributors in all principal cities, Reading-Pratt & Cady offers a single responsible source for practically all of your valve requirements. Moreover R-P&C can give you the benefit of long experience toward getting more economical service from your valves.

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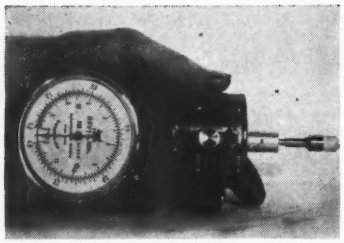
TRADE MARK



that each dial is individually calibrated for each instrument. The finest results may be obtained and revolving shafts can be measured as close as 1 rpm. In the Model A, the hand reads to 1 rpm and fractions of one revolution may be estimated. In the 100 to 400 range each graduation shows 5 revolutions, in 300 to 1200 ten revolutions, in the 1000 to 4000 range each line is 50 revolutions while in the 3000 to 12000 range each graduation is 100 revolutions. Attachments are also provided to give feet per minute.

Nine Per Cent Nickel Steel Tubing

A NEW APPLICATION of the recently developed 9 per cent nickel steel in tubing designed especially for subzero temperatures has been announced by The Babcock and Wilcox Tube Co., Beaver Falls, Pa., manufacturers of the new product. This is the first time that this high nickel-bearing steel has been made available in tubular form.

Developed primarily to answer the pressure tubing needs of plants handling liquefied gases or other low temperature fluids, the new nickel steel tubing exhibits good physical properties even at temperatures as low as minus 320 F.

According to H. D. Newell, chief metallurgist and director of the Tube Company's laboratory, the new product may be applied in low temperature work as a substitute for 18-8 stainless steel tubing. It is also probable that it can be used for special pump tubing handling salt water and hydrogen sulphide which present a difficult corrosion problem. Other applications are in the tubes for black liquor evaporation (in the preparation of waste black liquor for burning in the Kraft paper industry), for caustic solution evaporation, and for alkaline-phenol solution work.

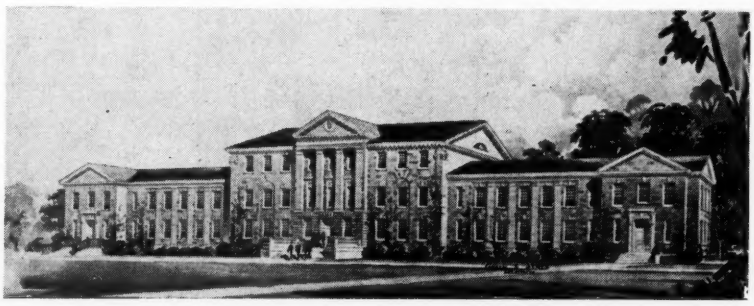
The new 9 per cent nickel steel tubing is capable of giving Charpy impact values as high as 25 foot pounds, even at the minus 320 F temperature. The new alloy will offer resistance to attack by alkaline media and to low temperature embrittlement to a greater degree than any other nickel alloy steel tubing regularly produced by the company.

Minimum tensile properties of the tubing are specified as follows: ultimate strength, 80,000 psi; yield strength, 50,000 psi; and elongation, 20 per cent in 2 in. The use of electric furnace steel only is recommended with nickel content ranging from 8 to 10 per cent and carbon held to 0.12 per cent maximum. The steel should be a fine grained type, irrespective of the end use.

Tool for Replacing Gaskets

FLANGE-JACKS, a new tool for opening pipe flanges for gasket renewal quickly, easily, and safely, has been developed by T. G. Persson Co., 224 Glenwood Ave., Bloomfield, N. J. With them pipe flanges may be opened or closed without damage to flange faces, and without danger from sparks, an important factor when working on inflammable lines or in presence of gas fumes. Danger to personnel from chips and flying wedges is also eliminated.

These tools are extremely convenient when working in tight, cramped locations. They exert tremendous pressures smoothly and evenly, without vibration along the pipeline and the likelihood of causing new leaks in nearby joints. They are capable of opening joints against a load of 15 tons, and as pressure is exerted, flanges open steadily and bolt holes are maintained in continuous alinement. Closures are accomplished in a similar manner. Standard size Flange-Jacks open all 2 to 20-in. flanges and hold them in perfect alinement.



University of Buffalo Engineering Building

ON NOVEMBER 5 the University of Buffalo broke ground for its new engineering building which is planned in three sections, only one of which—the center and main section—will be constructed at this time. It is expected that this portion of the building will be completed within a year and it is planned to be four stories in height, with a one-story laboratory extension at the rear. This extension will house the main mechanical engineering laboratory having 7000 sq ft of floor space. The ground floor will contain an Instruments Laboratory, Fuel and Lubricants Laboratory, Machine Tool and Production Inspection Laboratories, and two class rooms, designed for the use of visual aids.

On the first floor will be a Heat Treatment Laboratory, Materials Testing Laboratory, and office and class room facilities. The second floor is reserved for the electrical laboratories. It will also contain a constant-temperature, windowless room to house the Gage Laboratory which has been transferred to the University of Buffalo from the Army Ordnance. The third floor provides 5000 sq ft of drafting room space.

Chancellor Samuel P. Capen has pointed out that the engineering building is a necessary part of the expansion program announced by the University in 1944 when its four year curriculum in Mechanical Engineering was begun. The building will house the department of Mechanical Engineering, which has already grown to unexpected size and will provide the nucleus for expansion which is expected to include Electrical and Chemical Engineering in the near future. When completed the building will be 307 ft wide.

At present it is reported that there are 85 freshmen and 25 sophomores registered which is about 50 per cent more than had been expected. In addition there are 35 freshmen, 23 sophomores and 25 juniors taking engineering programs in the evening and the proportion of these students who are working toward degrees is higher than expected.

A full-time student body of 285 in engineering by 1948 is now indicated.

"Trifles make perfection but perfection is no trifle"

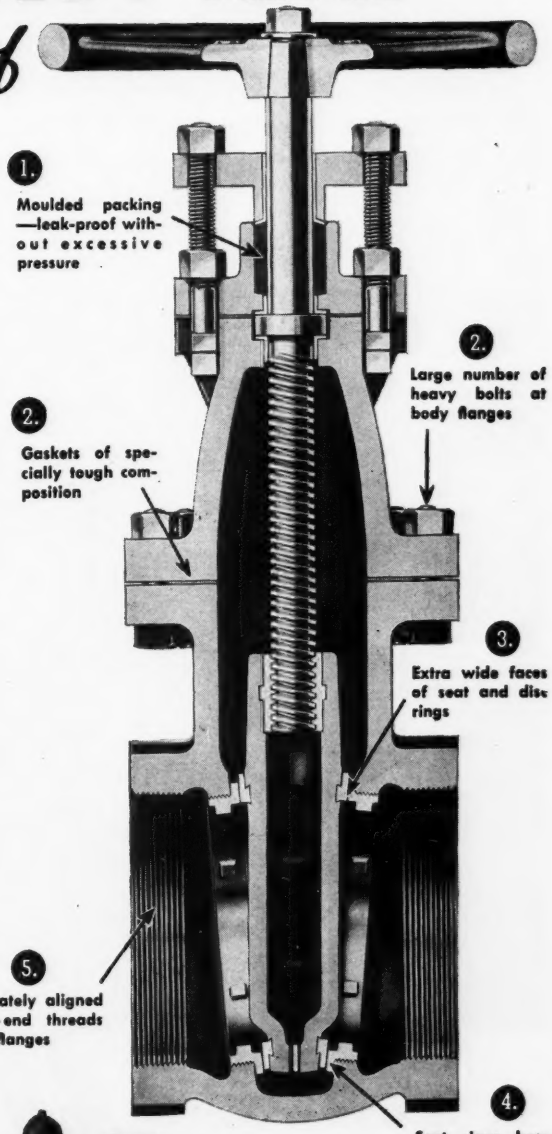
One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

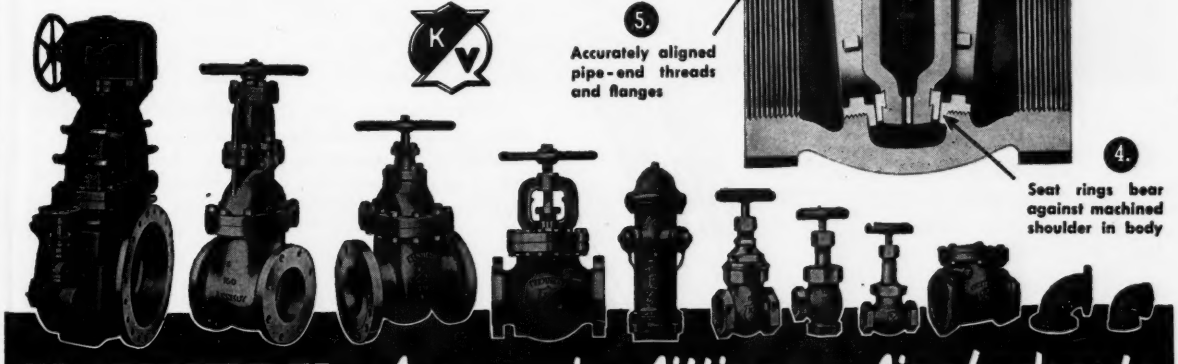
5 Features that make KENNEDY valves lastingly leak-proof

1. LEAK-PROOF at the STUFFING BOX . . . without excessive friction . . . because of accurately fitting glands, stems and bushings with moulded packing.
2. LEAK-PROOF at BODY-BONNET JOINT . . . because of gaskets of specially tough composition and large number of heavy bolts at body flanges.
3. LEAK-PROOF between DISCS and SEATS . . . because of extra wide faces of seat and disc rings, with accurate machine work and rigorous factory tests.
4. LEAK-PROOF between SEATS and BODY . . . because seat rings are securely screwed into body and bear tightly against shoulder in body.
5. LEAK-PROOF at END CONNECTIONS . . . because of accurately aligned pipe and threads and flanges.

Lasting tightness is but one of the many details to which Kennedy gives extra care . . . and extra value . . . in valve design and construction. The Kennedy Catalog describes all these special features and will help you make a selection for trial. Your copy sent on request.

The Kennedy Valve Mfg. Co.
Elmira • New York





KENNEDY valves . . . pipe fittings . . . fire hydrants

RUBBER PLANTATION — AMERICAN STYLE

The only three butyl rubber plants in existence . . . those at Baton Rouge, Louisiana; Baytown, Texas; and Sarnia, Ontario . . . were engineered and built by Stone & Webster Engineering Corporation. In view of the many specialists required for each plant's design, erection and ultimate operation, we also acted as the coordinating agency.

Pictured above, unit #2, butyl rubber plant, Baton Rouge, Louisiana, operated by Standard Oil of New Jersey (Louisiana Division). Largest and first to go into operation; design capacity is 33,000 long tons of butyl rubber per year.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

COCHRANE Deaeration SAVES!

Deaeration of boiler feedwater is one of the big items of economy in power plant operation.

Cochrane Deaerators of varying sizes, designs and construction have been protecting the boiler plants of industry for many years. The feed piping, economizers, water walls and tubes of these boilers are effectively protected by Cochrane Deaeration, which removes both dissolved oxygen and soluble gases, and at the same time produces savings in heat and fuel by heating the water to the boiling point.

COCHRANE CORPORATION 3123 N. 17th ST., PHILADELPHIA 32, PA.

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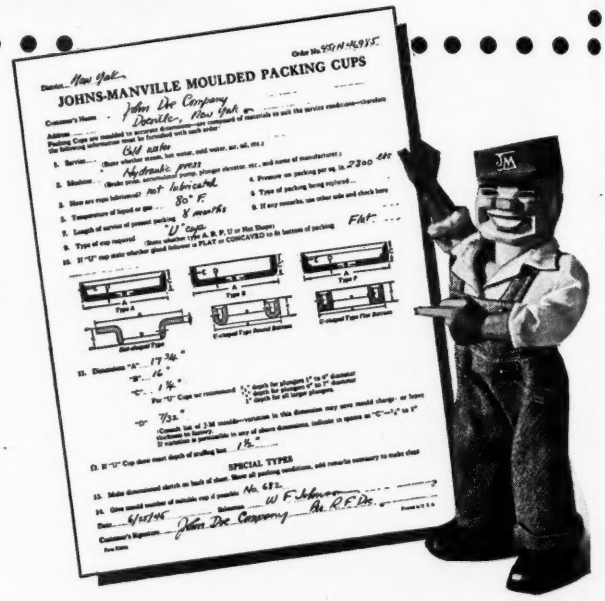
1. YOU FILL OUT THIS SIMPLE FORM

This simple data sheet can help you get increased packing efficiency. It supplies information from which Johns-Manville moulds packing cups to meet your specific needs. In terms of reduced costs and longer packing life, it will pay you to make use of this easy-to-fill-out form, obtainable from your J-M Packing Distributor.



2. WE TAILOR THE PRODUCT TO FIT THE JOB

From this information, J-M Moulded Packing Cups are "custom-tailored," moulded to your requirements in shape and size, as well as composition. This may vary, depending on whether they are to seal against air, water, steam, oil, etc., or to operate against high or low pressures and temperatures. The result is a packing cup that wears longer and provides a positive seal with minimum friction on all types of hydraulic and pneumatic equipment.

With these tailor-made J-M Packing Cups, you can be sure of getting the right packing . . . *right* in composition, size and shape for *your* needs. For further details write Johns-Manville, 22 East 40th Street, New York 16, N. Y.

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SPECIFY Vogt

DROP FORGED STEEL
VALVES, FITTINGS & FLANGES

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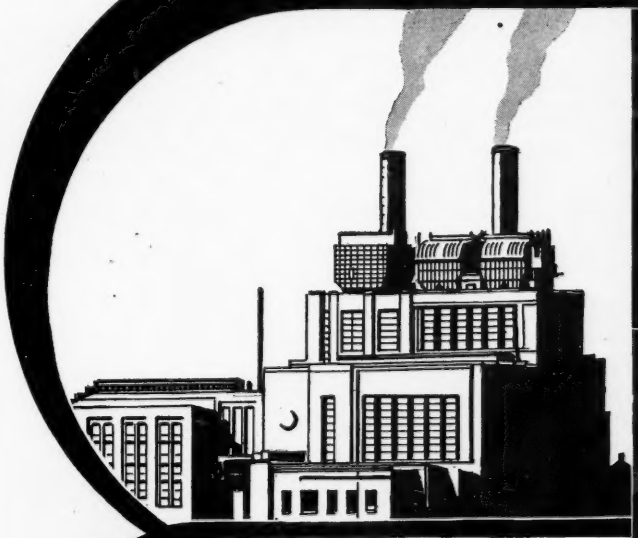
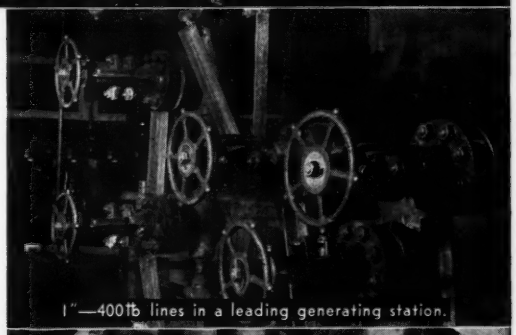
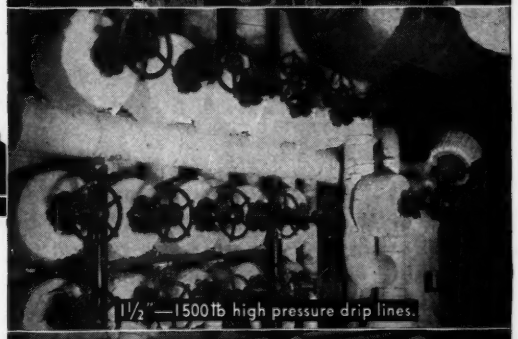
STEAM GENERATING PLANTS

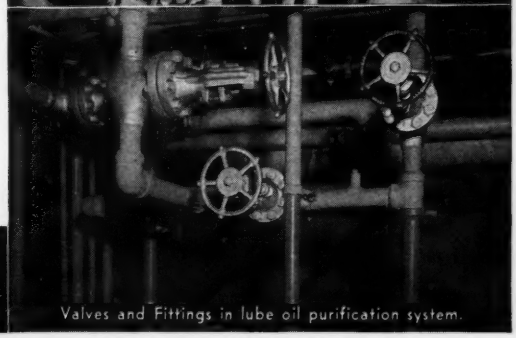




1"—400lb lines in a leading generating station.



1½"—1500lb high pressure drip lines.



Valves and Fittings in lube oil purification system.

SAFE and SURE control of vapors and liquids at high pressures and high temperatures in modern steam generating plants is dependent on piping materials having an inherent "plus" of strength and toughness. *Drop forged steel* Valves, Fittings, and Flanges made by Vogt play a vital part in the smooth, efficient operations of leading power plants.

Catalog F-8 is the drop forged steel Valves and Fittings Blue Book.

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HERE'S HOW PROCESSING LINES ARE *Fortified* AGAINST VALVE TROUBLES

Look at the Streamlined flow pattern directly above. It results because of the Streamlined form of the inner valve. On your lines it means smooth, dependable valve action day after day through years of service without attention. Proof of this is in what so many users say . . . . "put the '1000' on the line and forget it."

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE REDUCING VALVES

When you put this Streamlined construction on your lines you have no complicated parts to get out of order, no small ports or passages to clog up. There are no close fits. It's straight line flow all the way — flow that gives you maximum capacity, close delivery pressure control, and tight closures — flow that saves you money all along the line — flow that means elimination of failures — speedier production and no spoilage.

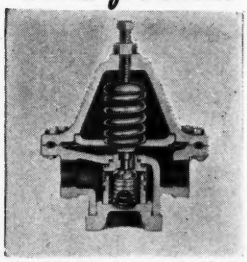
BULLETIN 962—features the CASH STANDARD Streamlined Type 1000 Pressure Reducing Valve—illustrates the streamlined construction and tells why you get exceptionally long, trouble-free, low-cost performance. Points out why you get no turbulence and therefore can meet peak demand at all times. Explains why straight-line flow gives you maximum capacity, close delivery pressure control, and tight closure..'

CASH STANDARD CONTROLS.. VALVES

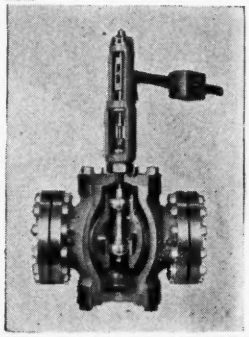
A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

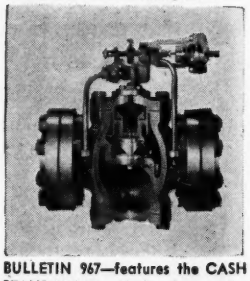
Send for them



BULLETIN 950—features the CASH STANDARD Type D Single Seat pressure Reducing and Regulating Valves for use with most fluids. Shows simple inner working parts that save in maintenance. Diagram explains how valve works. Blueprint shows simplicity of installation.



BULLETIN 965—features the CASH STANDARD "42" Series—a complete line of balanced lever valves for handling almost anything that will flow through a pipe except some injurious chemicals. Two full pages show 16 installations with descriptions.



BULLETIN 967—features the CASH STANDARD Tye II Condenser Water Regulator — self-contained — pilot-operated for controlling the flow of cooling water to condenser coils. Used with water or air —with any gas or oil that is non-corrosive—and with all refrigerating fluids. Blueprints show installation at outlet of condenser and at inlet. Capacity charts are shown.

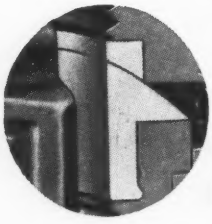
ROTO
TUBE CLEANERS
for UNION BOILERS

The Roto equipment illustrated will clean all the tubes in the many different designs of Union Iron Works—Bent Tube and Straight Tube—Boilers ranging in capacity from 20,000 to 120,000 lbs. steam per hour. Roto Tube Cleaners for these and other type boilers are stocked ready for instant shipment. Engineering assistance on special tube cleaning problems gladly furnished. Write, wire or phone us your requirements.

Roto Model 125 Air-driven Motor with No. 330-1 four-arm head and six-way drill for cleaning 3" curved tubes.

ROTO Division of ELLIOTT COMPANY
145 SUSSEX AVENUE - - - NEWARK 1, N. J.

It's Hard to Damage



TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT PERMIT EASY CLOSING AND OPENING

Because the two bronze seats in a Dart Union close to form a true ball joint, ruinous wrenching is unnecessary. And if the union is needed for some other service, uncoupling is effected with equal ease. Body and nut are of high-test air-refined malleable iron—are practically indestructible. That's why Dart Unions are cheapest in the long run.

Next time your supplier calls, ask to see the Dart Union construction.

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DART UNIONS

Houdry Process

(Continued from page 122)

are more severe than encountered in domestic plants. As a result, the power variations are correspondingly greater. When it is desired to iron out these swings, this can be accomplished by operating the auxiliary steam turbine at some partial capacity so that its power plus the turbo's excess power equals the desired yearly average output. In the Houdry application, where the turbo unit functions primarily as an air compressor, the relatively minor seasonal variations in air flow do not present a process problem.

Cyclic Variations

It has been seen that variations in air flow rate due to seasonal changes in ambient air temperature affects the turbine inlet and compressor discharge pressure, the system pressure drop and power. Though to a lesser extent, changes in the products of combustion of the coke deposit also affect the foregoing as shown in the graphs of Fig. 7 page 122, for a typical regeneration. The marked decrease in flue gas when part of the compressed air is diverted to repressure the purged catalyst cases next in line for regeneration is responsible for the major cyclic power dip. As the repressuring power loss is substantially constant throughout the year, it has been applied to the seasonal trend curves to obtain the maximum power demand shown as the dashed line of Fig. 6.

The electrical power developed during the regeneration graphed on Fig 7 is not truly indicative of machine efficiency and excess power generated because some steam was being used in the auxiliary turbine to adjust power levels. This, of course, does not affect the cyclic variations under discussion. To minimize the power demand during repressuring, this period is spread out over a period of about two minutes and the flow of repressuring air is limited to a more or less constant flow rate by mechanical throttling. If the catalyst cases were repressured suddenly, the power demand surge would increase proportionally. If desired, the surge could be eliminated by repressuring from a tank fed continuously by the compressor, but this refinement has not been warranted.

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[1]A. R. Pew, Jr., *Power*, August, 1945, also POWER PLANT ENGINEERING, August, 1945.

[2]C. D. Flagle and F. W. Godsey, *Automotive and Aviation Industries*, June 1, 1945.

[3]P. R. Sidler, *Power*, March, 1944.

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[5]J. K. Salisbury, *Mechanical Engineering*, June, 1944.

[6]B. M. Mills, *Petroleum Refiner*, October, 1943.

[7]*World Petroleum*, July 15, 1943.

[8]J. T. Rettaliata, *Power*, December, 1939.

[9]J. Goldsbury and J. R. Henderson, *Petroleum Refiner*, December, 1941.

[10]The Modern Gas Turbine, by R. Tom Sawyer; Prentice-Hall, Inc., 1945.

Edge Moor vertical flow Bent Tube Boiler . . .

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• Edge Moor boiler design is and always has been flexible. No single type will furnish steam under all circumstances and requirements as satisfactorily and economically as a boiler adapted to those requirements and conditions.

• The Edge Moor Vertical Flow Boiler is designed for maximum output in a limited space. It is a combination of a simple two-drum boiler bank, having perfect U-tube circulation, and a water cooled furnace, integral with the boiler. The large amount of surface exposed to radiant heat results in a quick steaming unit that will give rapid response to load changes.

• The Edge Moor Vertical Flow Boiler is adaptable to all methods of firing both solid and liquid fuels. It is available in sizes from the smallest to units capable of generating 200,000 lbs of steam per hour.

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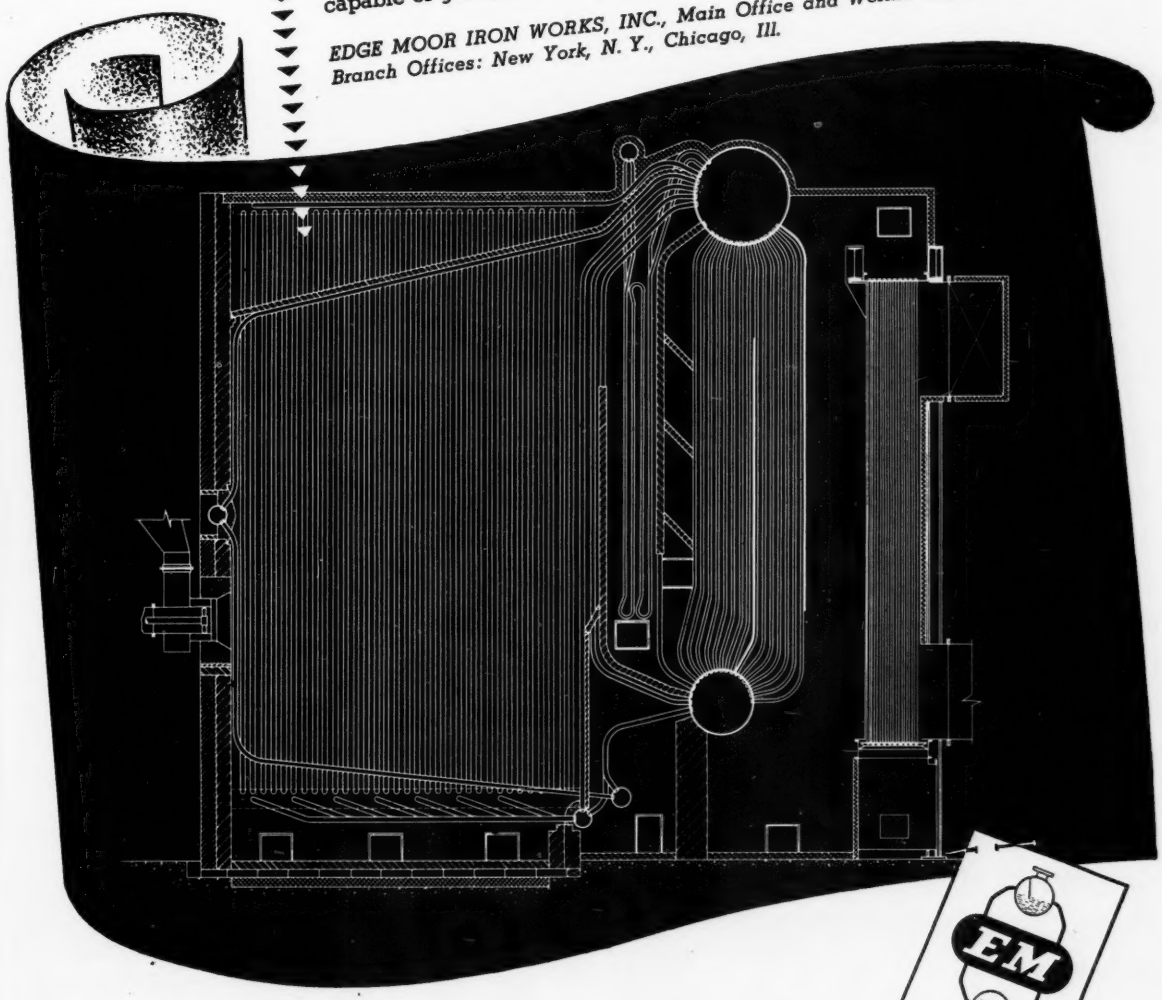

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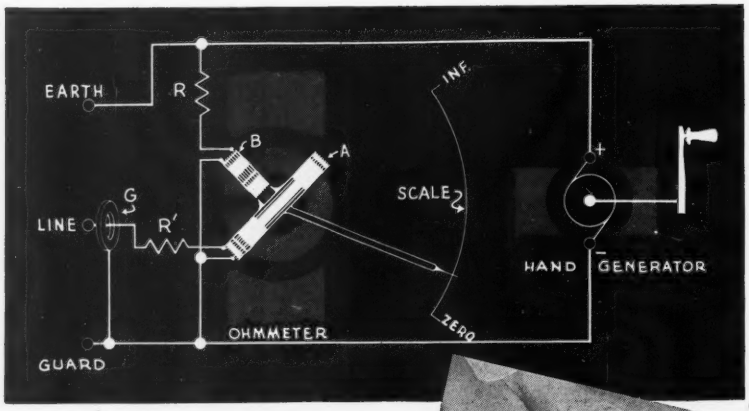

In what we term a cross-coil true ohmmeter, two coils are mounted in fixed relation to each other on the same pivot-and-jewel moving system in the field of a permanent magnet. "Current" flows in coil A and "potential" in coil B, and they are connected so that their respective torques oppose each other. Since there are no control springs, the opposing coils give a true ratio of E/I, and ohms (or megohms) are indicated by a pointer over a scale. The readings are independent of the voltage of the hand-driven d-c generator, because any change in the voltage affects both coils in the same proportion.

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Obituaries

John J. Brown

JOHN JACOB BROWN, of Cranford, N. J., and Biddeford Pool, Me., died in St. Luke's Hospital, New York, on February 15 after a brief illness. He was 73 years old.

At the time of his death, Mr. Brown was Chairman of the Boards of the Foster Wheeler Corp., New York, and Foster Wheeler, Limited., St. Catherine, Ontario, Can. Born in Tyler, Texas, on January 19, 1873, he was the son of John A. and Emma (nee Sanford) Brown. He married Mary Katherine McCoole of St. Louis, Mo., in 1922.

Mr. Brown started his business career as a construction engineer for the Consolidated Compress Co. of Texas in 1895. Later he became associated with Henry R. Worthington Pump Co. of New York as specialist on the development of hydraulic equipment for compressing cotton. When Worthington became part of the International Steam Pump Co., he was made general western manager for the latter, with headquarters in Chicago. In 1907 he became vice president of the Wheeler Condenser and Engineering Co., N. Y., and was elected president in 1918. During World War I he acted as chairman of the Condenser Committee, War Industry Board, and was a member of the Non-Ferrous Metals Committee.

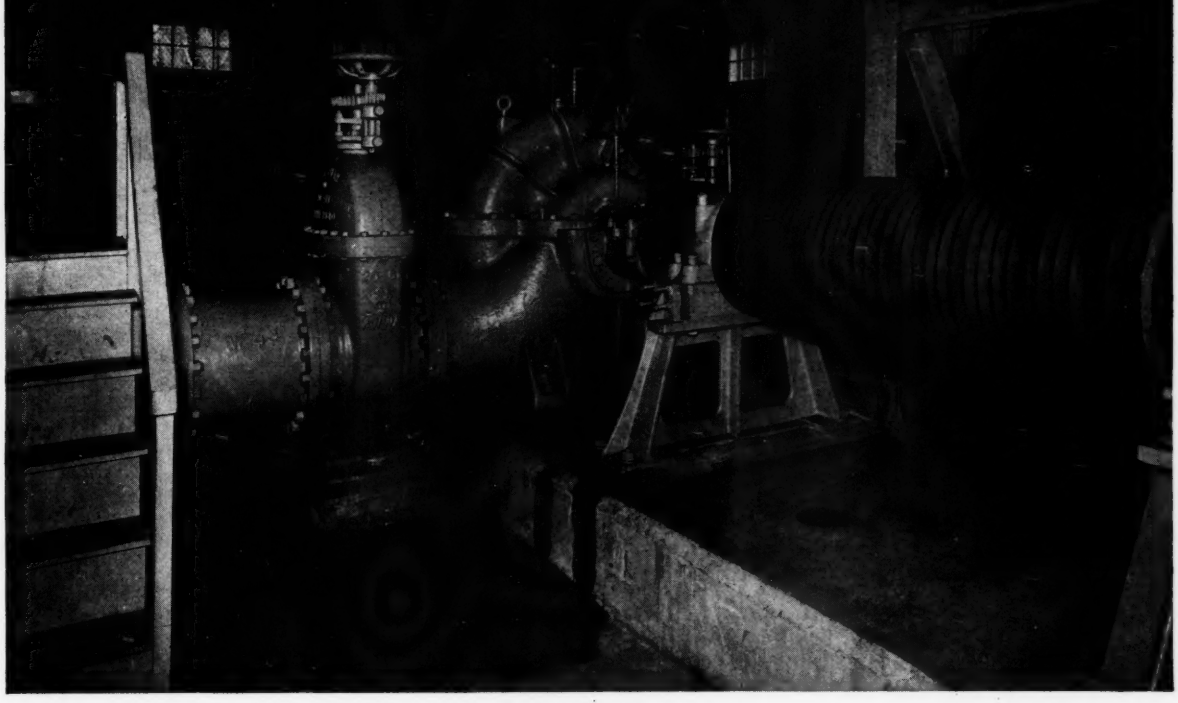
Upon consolidation of the Wheeler Condenser and Engineering Co. and the Power Specialty Co. as the Foster Wheeler Corp., Mr. Brown was elected chairman. In 1923 he organized the Carteret (N. J.) Bank & Trust Co. and served as its president until 1928. He was a director of Fidelity Union Trust Co. of Newark, Cranford Trust Co., General Regulator Corp. and Liberty Mutual Insurance Co. for which he also served as a member of the New York advisory board; and was a member of the American Society of Naval Architects and Marine Engineers and New York Southern Society. Club affiliations included Engineers, Bankers, Recess, Baltusrol Golf and Abenakee. He was a member of the American Society of Mechanical Engineers.

NEWS *from* THE FIELD

Program for Midwest Power Conference

AFTER A LAPSE of one year, the Midwest Power Conference will be active

It didn't happen...BUT



DURING the war the Metropolitan District Water Supply Commission of Boston was prepared to meet the emergency which *could* have occurred if its Chestnut Hill Pumping Station had been bombed or sabotaged.

Within an exceptionally short time . . . in a comparitively small space . . . the Commission built an emergency pumping station which had an available capacity of 45 million gallons daily in case of necessity.

To accomplish this, two Warren 18-DL-25 pumps were used, one direct-connected to a 900 HP motor and the other V-belted to a 1250 HP motor (see illustration). These pumps were originally built by Warren for de-watering service in the Quabbin Tunnel project of the Metropolitan District Commission. Thus Yankee ingenuity, plus the versatility of Warren Pumps and Warren engineering, made another worthwhile wartime contribution.

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. . . or other services, your inquiry will receive prompt attention.

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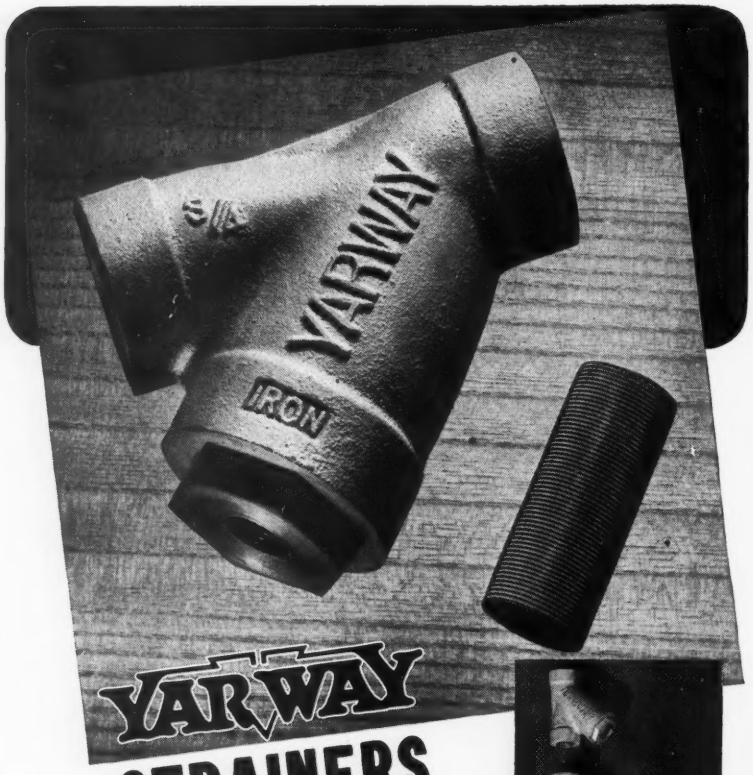

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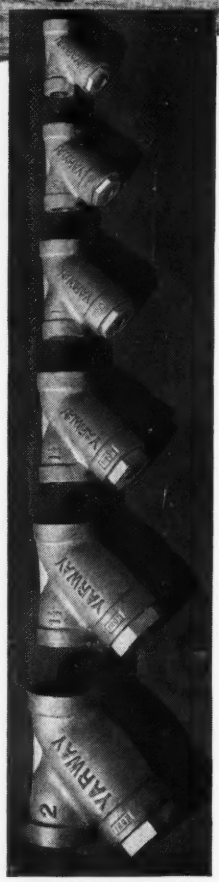

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YARWAY STRAINERS

this year with a well balanced program of interesting and timely power topics presented in papers by authorities well known in engineering circles. Since its reorganization in 1938 as a cooperative institution with university and technical society associations, the responsibility and sponsorship of the Conference has been centered in Illinois Institute of Technology.

This year the Conference is being extended to three days, instead of two as previously, April 3, 4 and 5 and will be held at the Palmer House, Chicago, Ill. As established in the past, the purpose of the conference is to offer an opportunity for all persons interested in power production, transmission or consumption to meet for the study of mutual problems free from the restrictions of required memberships in technical or social organizations.

Stanton E. Winston of the Illinois Institute of Technology is Conference Director and C. A. Nash of I.I.T. is Secretary from whom additional information regarding the Conferences may be secured. Following are the essential features of the program which has been released for publication:

Wednesday, April 3, 1946

10:15 a.m. Opening Meeting, L. E. Grinter, Chairman; Address of Welcome, James D. Cunningham; Response, T. R. Agg; Atomic Energy, P. W. Swain; Future Requirements and Trends in the Use of Electric Power, Howard P. Seeyle.

12:15 p.m. Joint Luncheon with ASME, J. C. Marshall, Chairman; Speaker, Alf Kolflat, "Problems in Power Plant Design."

2:00 p.m. Central Station Practice, P. F. W. Waller, Jr., chairman; Automatic Control of Steam Generators and Auxiliaries, P. S. Dickey.

Developments in Air Conditioning, James S. Locke, Chairman; Centrifugal Compressors, W. H. Carrier; Cooling Tower Selection, J. Lichtenstein.

3:30 p.m. Feedwater Treatment, C. H. Fellows, Chairman; Problems in Water Conditioning in Plants Using High Percentages of Makeup, Leo F. Collins.

Recent Electric Developments, J. S. Gault, Chairman; Transmission - line Fault Locater for the Rio Negro Project, Kenneth W. Jarvis; The Use of Silicone Insulation, G. L. Moses; The Application of Rotating Regulators, L. T. Rader.

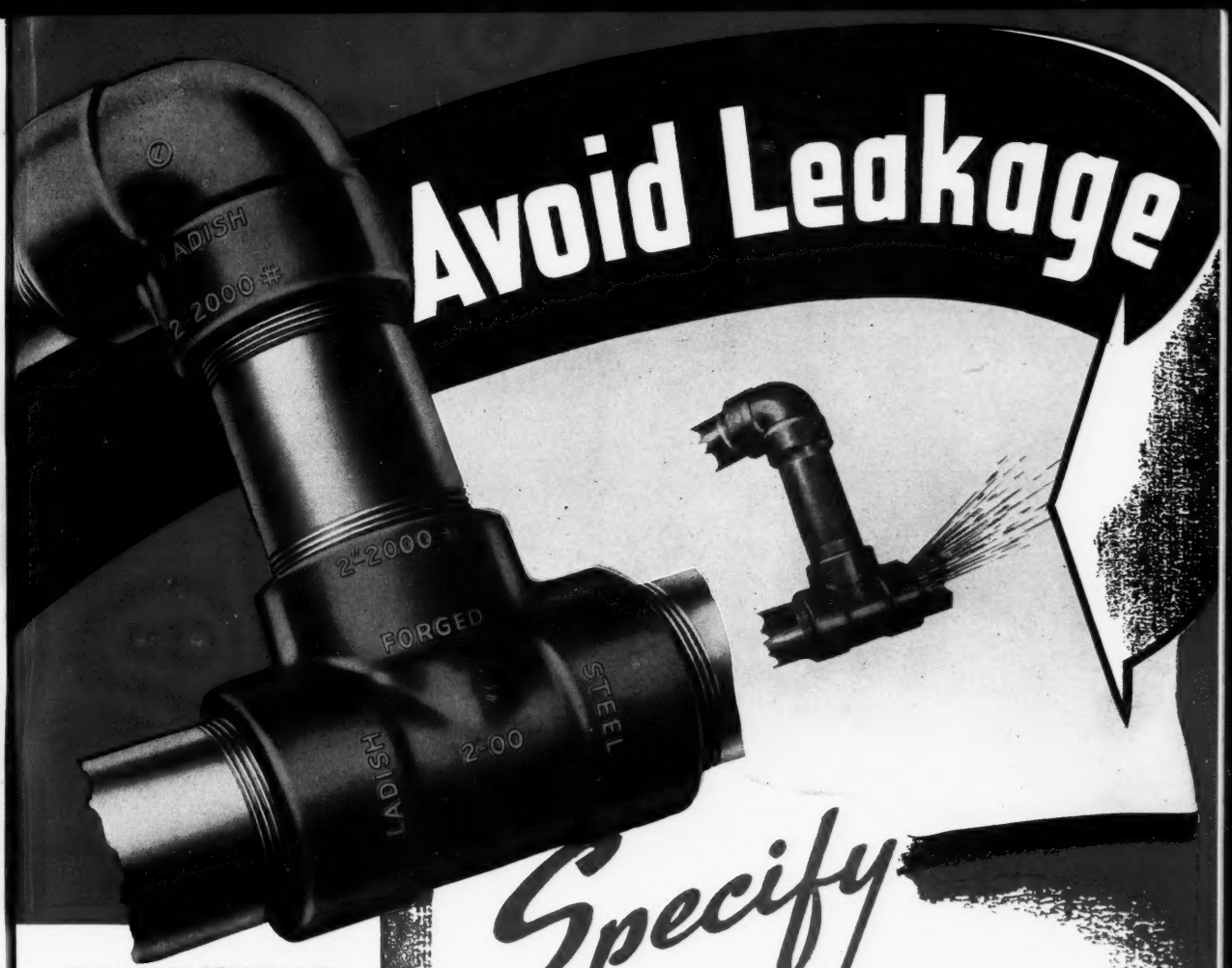
Thursday, April 4, 1946

9:00 a.m. Parallel Operation and Interconnection, E. W. Kimbark, Chairman; Damper Windings for Waterwheel and Diesel Generators, W. L. Ringland; Power Exchange in Interconnected Systems, C. W. Mayott.

Developments in Space Heating, Ralph E. Turner, Chairman; Radiant Heating, T. Napier Adlam; Industrial Applications of the Heat Pump, Philip Sporn.

10:30 a.m. Hydro Power No. 1, F. M. Dawson, Chairman; Present Status of the Proposed Hydroelectric Development of the St. Lawrence River, Carl Giroux; Hydroelectric Power in the Missouri Basin, B. H. Greene.

12:15 p.m. Joint Luncheon with AIEE, J. F. Calvert, Chairman;



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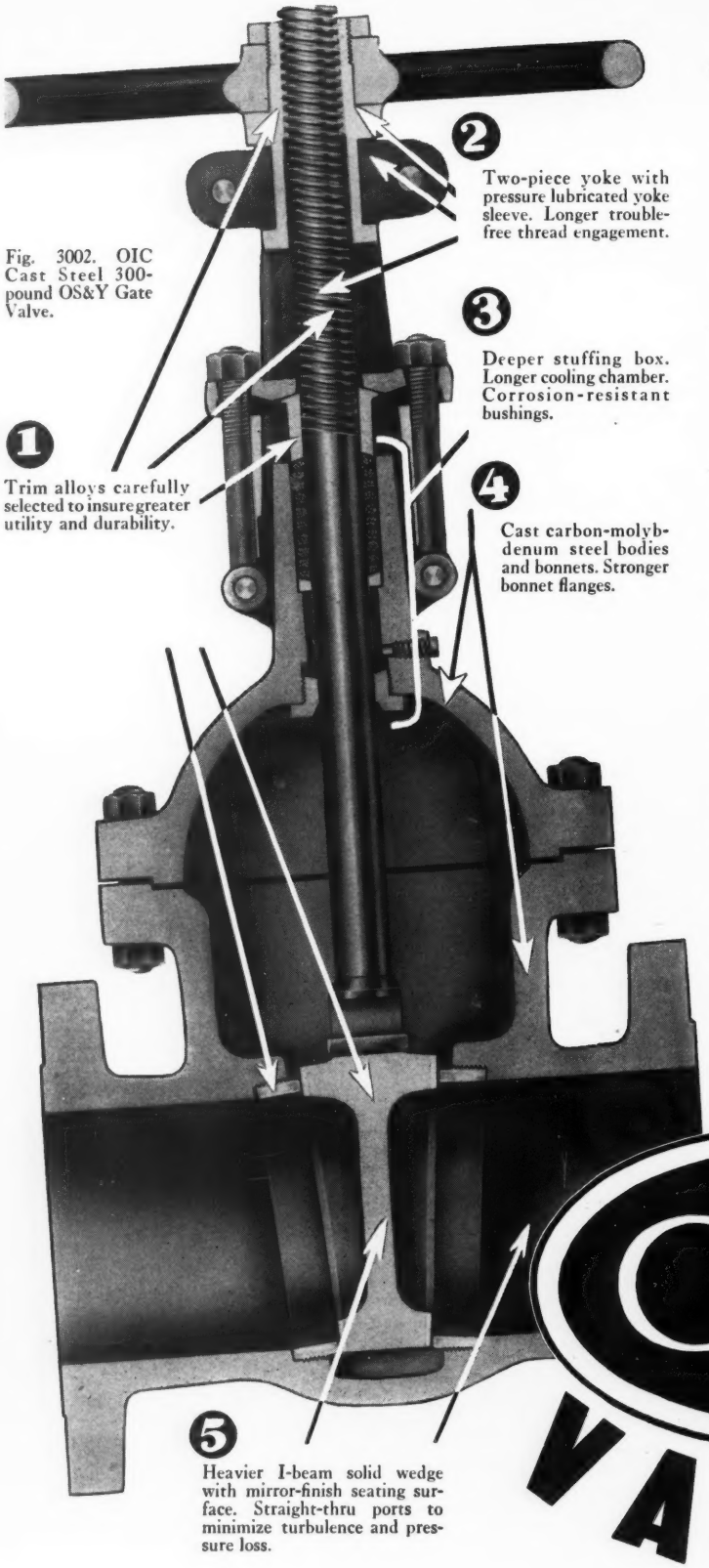
2
Two-piece yoke with pressure lubricated yoke sleeve. Longer trouble-free thread engagement.
3
Deeper stuffing box. Longer cooling chamber. Corrosion-resistant bushings.
1
Trim alloys carefully selected to insure greater utility and durability.
4
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5
Heavier I-beam solid wedge with mirror-finish seating surface. Straight-thru ports to minimize turbulence and pressure loss.

Fig. 3002. OIC Cast Steel 300-pound OS&Y Gate Valve.

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These are just two of the many reasons why OIC's are the proven valves of greater value, greater service and lower costs.

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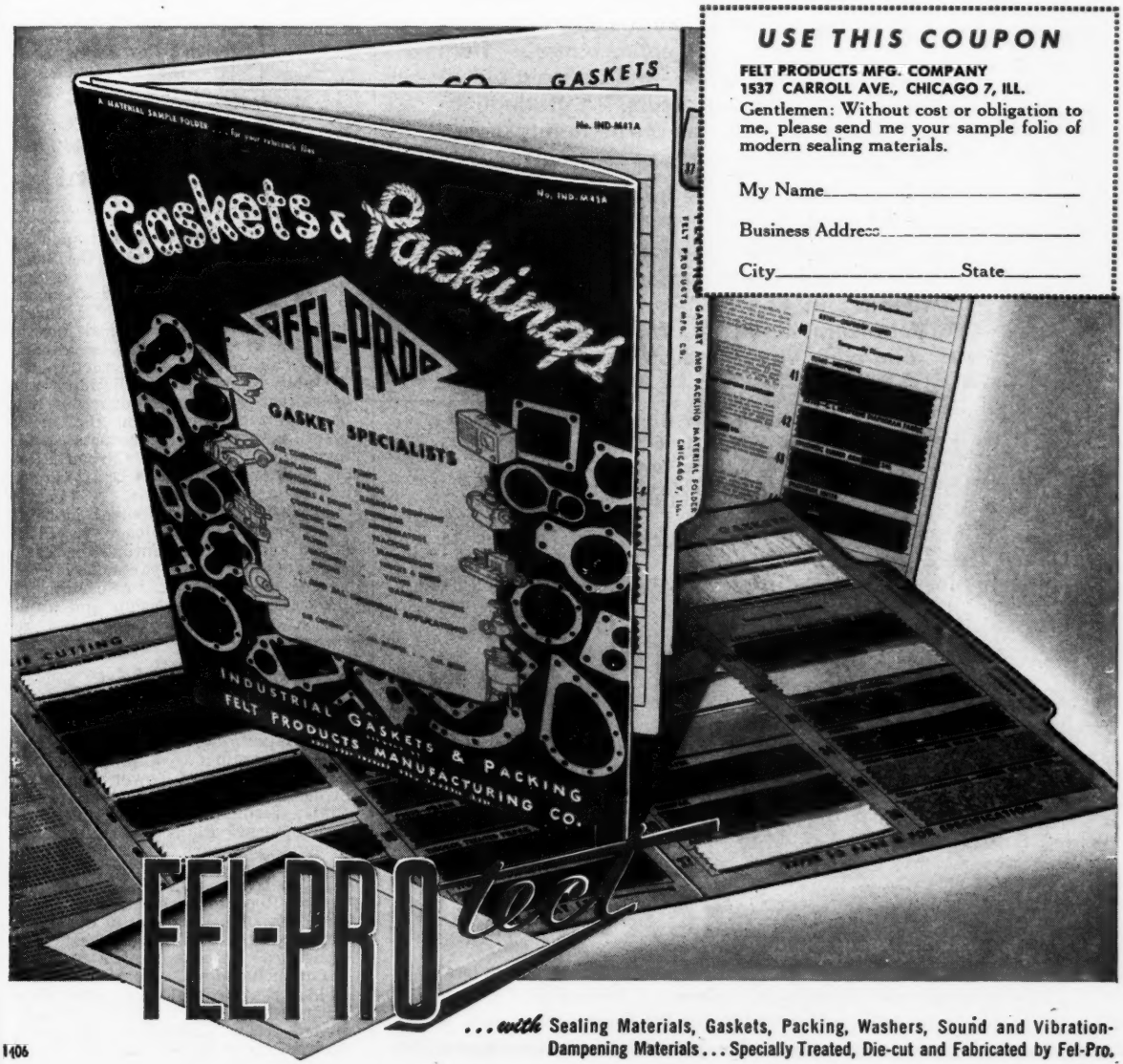

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Speaker, D. C. Prince, "Promotional Engineering."

2:00 p.m. Insulation Problems on Power Systems, C. E. Bauman, Chairman; Field Testing of Insulation, A. L. Brownlee; Transients in Electric Power Systems, H. A. Peterson; Review of Present and Future Conditions in the Cable Field, R. J. Wiseman.

Diesel Power, R. E. Summers, Chairman; Exhaust and Intake Mufflers and their Effect on Performance of Diesel Engines, Robert W. Huddle; Effect of Superchargers on Diesel Performance, Ralph Miller.

3:30 p.m. Gas Turbines No. 1, D. L. Arm, Chairman; Where the Gas Turbine Stands Today, L. N. Rowley and B. G. A. Skrotzki; Linear Relationships in Gas Turbines, John T. Rettaliata.

6:45 p.m. "All Engineers" Dinner. Speakers, Lieutenant General Raymond A. Wheeler and Rear Admiral John J. Manning.

Friday, April 5, 1946

9:00 a.m. Gas Turbines No. 2, H. O. Croft, Chairman; The Gas Turbine in Industry, J. R. Carlson.

Hydro Power No. 2, Ben G. Elliott, Chairman; Spillway Gate Operation to Prevent Erosion Below Dams, Arno Lenz; The Objectives and Benefits of the Wisconsin Valley Improvement Co., M. W. Kyler.

Bacharach Acquires Practical Instrument Company

IN A RECENT STATEMENT made by R. Ulrich, Vice President of the Bacharach Co., announcement is made that the Bacharach Industrial Instrument Co. of 7000 Bennett St., Pittsburgh, has purchased the Practical Instrument Co. of Chicago. The latter company has been manufacturing the portable temperature, humidity and operations recorders which will now be manufactured in the Bacharach plant as companion products to its line of portable Fyrite Carbon Dioxide Indicators, Draftrite Draft Gauge, and related instruments.

Manufacturing equipment is being transferred from Chicago to Pittsburgh and in the meantime the Bacharach engineering department is completing the development of certain improvements in the design and application of the moderately-priced recorders.

Power Projects in Central California

BUREAU OF RECLAMATION, regional office, Sacramento, Calif., has prepared a report of power and other projects in Central Valley district of State, recommended for immediate development. Plans for a number of proposed projects have been completed or are now in progress, awaiting Congressional action for necessary funds. Report has been made under authority of a Presidential order and in compliance with a request from Congress. Various power developments included and recommended are:

Pine Flat hydroelectric power plant, Kings River, capacity 45,000-kw, estimated cost $3,300,000; Monticello hydroelectric power station, Putah

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River, capacity 25,000-kw, estimated cost $1,700,000; Folsom hydroelectric power plant, American River, capacity 60,000-kw, estimated cost $4,500,000; Hot Springs hydrolectric station, Kern River, capacity 3500-kw, estimated cost $700,000; Bidwell Bar hydroelectric station, on Middle Fork, Feather River, 104,000-kw, cost $5,500,000; New Melones hydroelectric plant, Stanislaus River, capacity 48,000-kw, cost about $3,000,000; Tulloch power plant, Stanislaus River, capacity 20,000-kw, cost $1,500,000; Elbow Afterbay hydrolectric power plant, Feather River, capacity 20,000-kw, estimated cost $4,500,000; Table Mountain hydroelectric power station, Sacramento River, capacity 45,000-kw, cost $4,050,000; New Bullards Bar power plant, North Yuba River, capacity 60,000-kw, estimated cost $3,000,000; Nashville power plant, Cosumnes River, capacity 18,000-kw, estimated cost $1,500,000. Construction of a portion of proposed transmission system, for which plans are being arranged, is estimated to cost $32,600,000.

Report Showing Typical Electric Bills

TYPICAL ELECTRIC BILLS for residential service in all communities of 2,500 population and more in the United States as of January 1, 1945, are shown in a report issued recently by the Federal Power Commission. Residential bills are shown in the report for 3,830 communities served by 1,221 utilities. Of these communities 838 or about 22 per cent are served by 808 publicly-owned utilities, while 2,992 communities are served by 413 privately-owned utilities.

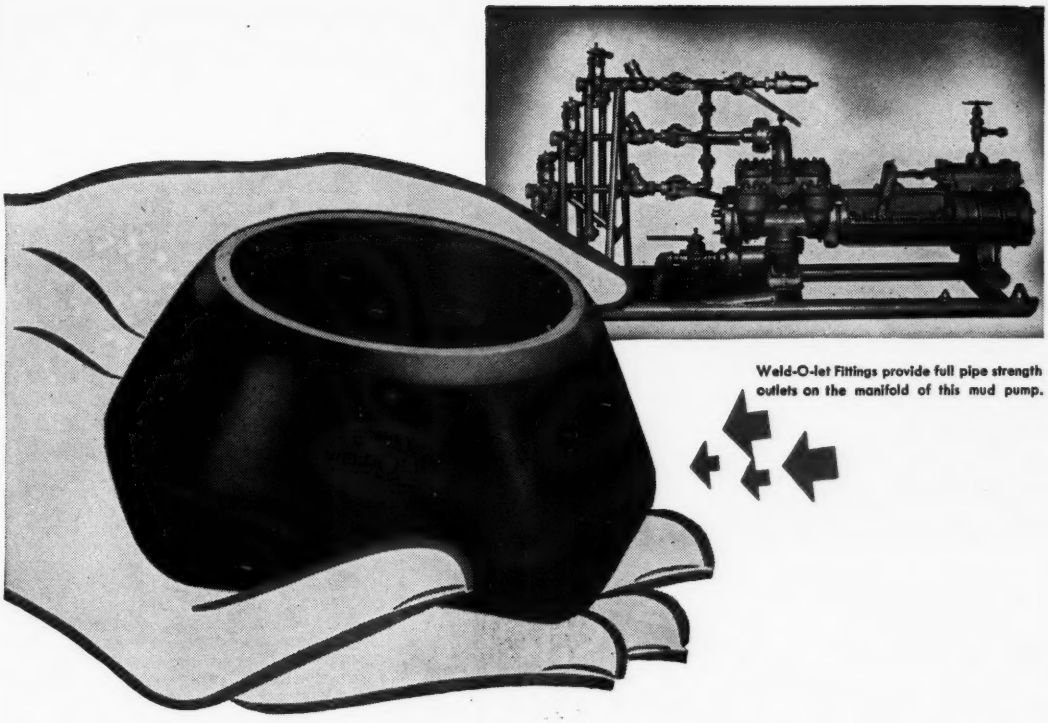
The report shows that wide differences persist between the lowest and highest residential bills for identical quantities of electric energy among communities in the same population groups. It is noted, however, that in general there are lesser differences today than were observed in 1935 when the first reports in this series were issued.

Comparisons with average bills for 1935 are also shown indicating the magnitude of the downward trend in residential rates that has taken place during the 10-year period 1935 to 1945. For the United States as a whole, average monthly bills for 100 killowatt-hours of residential service have decreased 16.7 per cent. Eight states — Arizona, Florida, Tennessee, Utah, Mississippi, Arkansas, North Carolina, and Idaho—all had reductions equal to 25 per cent or more of the 1935 average bill.

The publication, which may be referred to as FPC R-30 when ordering, will be sold at 25 cents a copy by the Federal Power Commission only.

New York City to Consider Sale of Power Plants

BOARD OF TRANSPORTATION, New York, N. Y., has opened negotiations with the Consolidated Edison Co., New York, relative to the sale of the three power plants of the city's unified transit system to that organization. Under a proposed program, all required power supply used on the



Weld-O-let Fittings provide full pipe strength outlets on the manifold of this mud pump.

Weld-O-let Fittings give you full pipe strength at branch outlet

● Whenever branch pipe outlets are made on any piping system, dangerous internal and external strains are encountered. These strains can cause trouble unless careful consideration is given to adequate reinforcement of the joint. And in most cases, this necessary reinforcement is a costly and time-consuming job.

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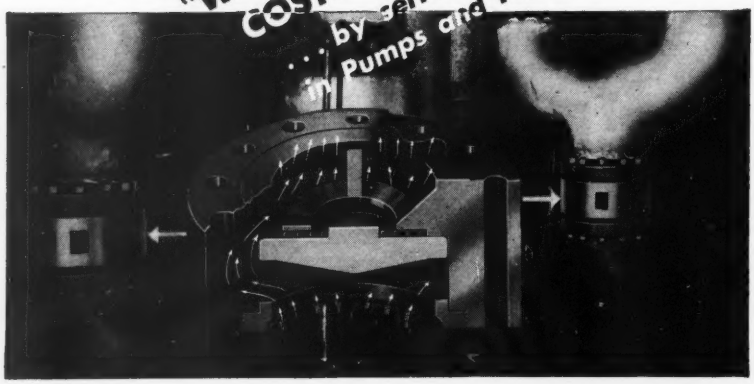
WELDOLETS
TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES
WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET
For Welded Branch Pipe Outlets

"WATER HAMMER" COSTS YOU MONEY!
. . . by serious breakdowns in Pumps and Piping Systems



WILLIAMS-HAGER FLANGED Silent CHECK VALVES

Precision Engineered to Eliminate "HAMMER and BANG" in ANY system with Operating Pressures up to 6,000 lbs.

Heavy duty service records upwards of 17 years without removal from lines . . . Williams-Hager Flanged Silent Check Valves are built to meet the exacting requirements of any end use. No webs to restrict or hamper the flow of liquids . . . the free-floating valve will operate normally and efficiently in *any* position.

Dependably constructed in sizes from 1" to 20" inclusive, from iron, semi-steel, bronze, cast steel, stainless steel or monel . . . pressure resistant to 6,000 pounds.

Do you have the new Williams Catalog for Power Plant Equipment?

specified by Leading Industries for such exacting uses as:

Public Utilities • Water Works • Industrials • Oil Refineries • Paper Mills • Hotels • Hospitals • Chemical Works • Office Buildings • Public Buildings • Breweries • Steamship Lines, etc.

THE WILLIAMS GAUGE COMPANY

Pump Valves . . . Water Gauges . . . Gauge Cocks . . . Pump Governors . . . Steam Traps Feed Water Regulators . . . Water Columns

3000 PENNSYLVANIA AVENUE • PITTSBURGH 12, PA.

system would be purchased from the Edison company in the future. The latter has been furnishing power for the IND division since it began operations in 1932, while the two other divisions of the subway system, known as IRT and BMT Divisions, respectively, have secured power requirements from the municipal-owned generating stations.

With the sale of the power plant on 59th Street, the city would save an estimated expenditure of $15,000,000, for proposed modernization and expansion in the next 24 months. Another generating plant on 74th Street is in poor condition, and the Edison company, it is said, is not particularly interested in taking over that property. The third plant in Williamsburgh district was partially modernized in 1938. On December 29, 1945, the Board cancelled a $390,000 contract with J. G. White Engineering Corp., New York, to supervise the proposed development and modernization program at the 59th Street station noted. This was initially intended to be the first major step in a program estimated at $104,000,000, to have the city furnish all power required for the transit system from municipal-owned stations. The program was developed by the White organization in two studies and investigations authorized by the Board of Estimate at a total cost of $90,000, the first being made in 1940 and the second in 1944. The Board of Transportation now holds that the Edison Co. generally can furnish power more economically than city-owned stations.

New Officers for Stoker Association

THE NEWLY ELECTED OFFICERS of the Midwest Stoker Association of Chicago, an organization of wholesalers and distributors of mechanical coal stokers, which were elected on January 9 are Joseph G. Beard, president who succeeds John J. Hayes. Mr. Beard is assistant manager, stoker division, Illinois Iron & Bolt Co., and Mr. Hayes is manager of the Auburn Stoker Co. Vice President, F. J. Moran, sales manager, C. E. Sundberg Co.; secretary treasurer, E. W. Jones, office manager, Iron Fireman Manufacturing Co. These three newly elected officers were also elected to the Board of Directors together with E. M. May, branch manager, Combustioneer Division, Steel Products Engineering Co., and A. H. Proche, branch manager of the U. S. Machine Corp.

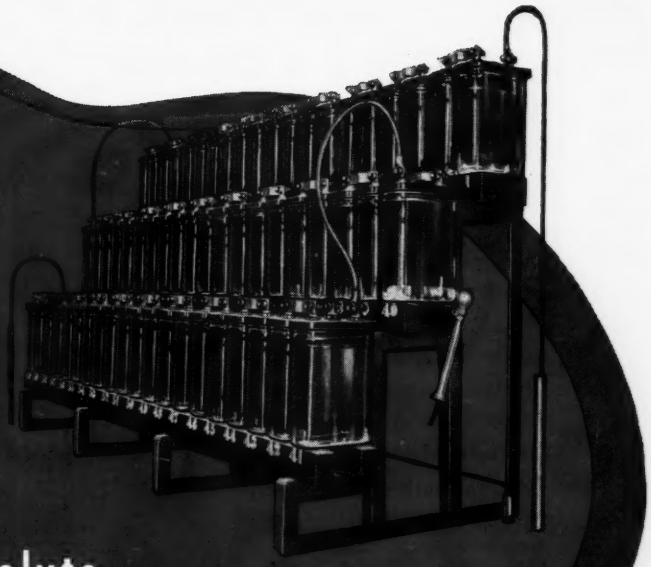
Public Service Corp. Budgets $17,000,000 for Construction

MORE THAN $17,000,000 has been authorized by Public Service Corporation of New Jersey for new equipment, extensions and replacements for its subsidiary operating companies in 1946. This does not include any part of the $23,000,000 estimated cost of the proposed new electric generating station at Sewaren.

Of the budget, $5,514,192 is for the Electric Department and $5,329,578 for the Gas Department of Public Service Electric and Gas Co.; $3,875,-

PROBLEM:

To find insulated cable for battery-charging leads—immune to attack by electrolyte



SOLVED WITH FLAMENOL CABLE

An Ohio steel mill required insulated cable for its battery-charging equipment, which consisted of a 250-kw generator and a 27-panel switchboard. Cable was needed for leads from panels to batteries. As the leads ran underground, the cable insulation had to withstand moisture as well as electrolyte fumes and accidental contact with the electrolyte itself. Four years ago, at G.E.'s suggestion, Flamenol* Style FL insulated cable was selected for the job. The mill reports that the original installation is still giving trouble-free service.

RESISTS CHEMICALS—Flamenol Style FL cable is highly resistant to oils, water, mild acids, and alkalies—and weather. It is tough and stable, is flexible at low temperatures, and has high dielectric strength. Flamenol does not support combustion—therefore, prevents outages due to fires. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Its insulation strips easily and leaves the conductor surface untarnished.

A G-E "FIRST"— Only G.E. makes Flamenol cable. Flamenol is the original cable insulated with plasticized polyvinyl chloride. G.E. introduced it in 1935—not as a substitute for rubber-insulated cable but as a new type possessing desirable properties not obtainable in rubber. To find out how Flamenol can help solve *your* problem—save you time, trouble, and expense—ask our local office, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

GENERAL ELECTRIC

502-54-1200

HERE'S A COMPLETE

LEVEL-TROL

HOOK-UP

A Fisher Level-Trol with full throttling pneumatic pilot, actuating a remotely installed FISHER DIAPHRAGM MOTOR VALVE — a control combination that guarantees the finest in liquid level control for heaters, condensors, deaerators and hot wells.

THE LEVEL-TROL

Insures extremely sensitive control — no measurable lag — pilot 100% pneumatic in operation — all linkage, pivot points and other sources of friction eliminated.

Torque tube construction eliminates stuffing box, packing and lubricator — free from gumming and sticking Float freely suspended — free from lost motion and guides.

Relay type pilot speeds action of the diaphragm valve in response to level change. Available in direct or reverse acting types. May be mounted either to the right or left of the float cage.

Proportional band adjustment makes it possible to vary the amount of level change necessary to fully stroke the diaphragm valve — minimum level change ½", maximum change equal to length of the float.

Level position adjustment permits level maintenance at any point within the length of the float.

THE DIAPHRAGM VALVE

Correctly engineered to respond accurately and with complete dependability to the dictates of the Level-trol pilot. Performance characteristic — straight line relation between pressure to diaphragm vs. stem stroke.

Several types of inner valves available — skirt guided or top and bottom guided — conventional throttling or percentage type characteristics. Selected materials for resistance to corrosion, erosion and galling.

Valve bodies have large flow passages to minimize friction losses and full port openings to develop full line area. Deep packing stuffing box with molded packing and lubricated.

FISHER GOVERNOR COMPANY

1031 Fisher Bldg., MARSHALLTOWN, IOWA

350 for Public Service Coordinated Transport and $1,997,600 for Public Service Interstate Transportation Co. The System Gas Companies of the Corporation—Atlantic City Gas Co., Peoples Gas Co. and County Gas Co. —are allotted approximately $365,000.

Laclede-Christy Expands

PURCHASE OF THE properties and business of the Alabama Clay Products Co., Birmingham, Alabama, by the Laclede-Christy Clay Products Co. of St. Louis, Mo., has recently been announced, the change taking effect on January 2. The properties effected will continue to be operated at the Alabama Clay Products Co. plant, a wholly owned subsidiary of Laclede-Christy.

Having contributed many of the developments now enjoyed by the users of refractory products over the past 100 years, Laclede-Christy has grown steadily in importance in the industry and as early as 1902, the Company recognizing the importance of scientific approach towards the advancement of better refractories and the solution of refractory problems, was the first to establish trained research and engineering staffs to serve the refractories user.

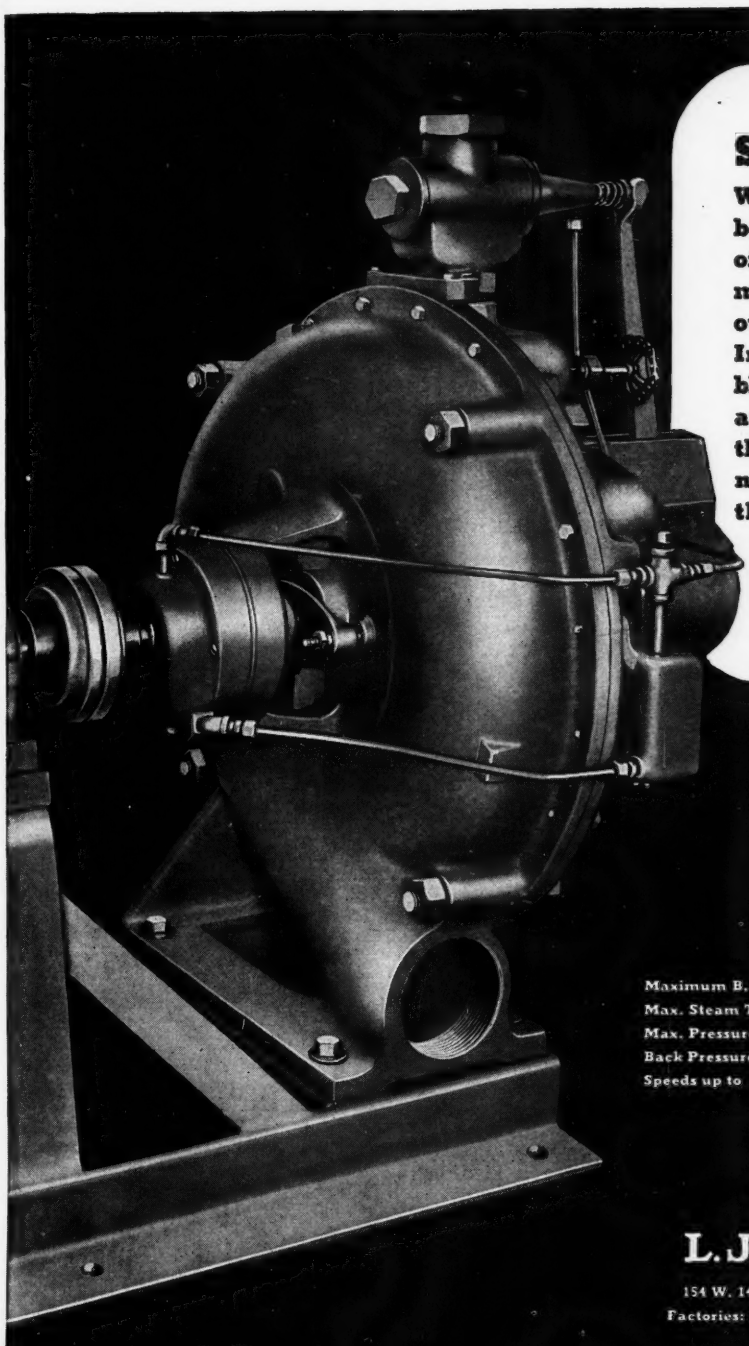
In 1931 Laclede-Christy acquired the Buckeye Clay Pot Co., Toledo, Ohio. Early in the war the Company, recognizing the possibility of refractories being a critical material in the war effort, modernized and materially enlarged its St. Louis plant. At the present time, three large plants are operated in St. Louis and Toledo, Ohio, for the manufacture of fire clay, refractories for the glass industry, high alumina products, refractory specialties, such as high temperature mortars, coatings, plastic, furnace cement and refractory castables, as well as vitrified products and sewer pipe.

A. S. Holberg, who has been President of the Alabama Clay Products Co., will continue to be with the Company. H. W. Gethin, Manager of the Pittsburgh, District of Laclede-Christy Clay Products Co., will be Vice-President and General Manager of the newly acquired Alabama properties and will live in Birmingham. The office of the Alabama Clay Products Co. will continue to be located in the Martin Building, Birmingham, Ala., while the main offices of Laclede-Christy Clay Products Co. are located in the Ambassador Building, St. Louis, Mo.

First Standardized Steam Turbine

WESTINGHOUSE ELECTRIC CORP. has under construction at the South Philadelphia plant, its first standardized steam turbine built for electric power generation. This 30,000 kw machine is for the Riverview plant of the Southwest Public Service Co. at Borger, Texas. It will help supply power to oil refineries, numerous carbon-black plants, and a synthetic rubber factory, and will provide power for irrigation facilities in the Texas panhandle.

Heretofore, steam turbines, which are the source of most of the nation's



SIMPLICITY

Wing Steam Turbines have been a dependable source of power in industrial and marine applications for over a third of a century. In the operation of fans, blowers, pumps and other auxiliary drive equipment, their simplicity, their economical performance and their ability to stand up under adverse conditions are outstanding characteristics.

OPERATING RANGES

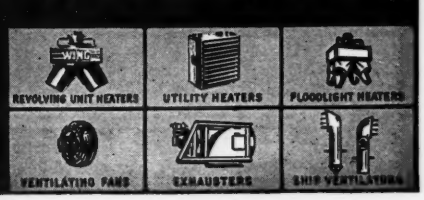
	STANDARD	HIGH PRESSURE
Maximum B. H. P.	100	150
Max. Steam Temp.	525 F.	750 F.
Max. Pressure	275 lbs.	600 lbs.
Back Pressure up to	50 lbs.	50 lbs
Speeds up to	4000 RPM	4000 RPM

Write for Bulletin SW-1

L. J. Wing Mfg. Co.

154 W. 14th St., New York 11, N. Y.
Factories: Newark, N. J. and Montreal, Canada

Wing TURBINES



FULLER ROTARY COMPRESSORS
BUILT FOR CAPACITIES TO 1800 C.F.M. PRESSURES TO 125 LB. VACUUMS TO 29.90 IN. REFERRED TO 30 IN. BAROMETER
ON VACUUM PUMPS
"SPOT" YOUR COMPRESSORS
FULLER
FULLER COMPANY

Why — excessive floor space and heavy, costly foundations?

Fuller Rotary Compressors require very little floor space in relation to capacity, have no vibration, and consequently require comparatively light, inexpensive foundations.

The installation illustrated above—two Fuller Rotary Two-stage Compressors, with individual motors, capacity each 750 c.f.m. free air, compressing from atmosphere to 100-lb. gage, were placed on foundations which formerly supported two conventional type machines with a capacity of 250 c.f.m. each, 100-lb. pressure... THREE TIMES the capacity on the same foundations!

"Spot your compressors . . . have air when, where and as you need it."

Bulletin C-5 illustrates and describes these machines. It's yours for the asking.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA
Chicago 3 · 1144 Marquette Bldg.
San Francisco 4 · 421 Chancery Bldg.
Washington 5, D. C. · 618 Colorado Bldg.

No. 4 of a series

C-112

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

mass-production power, have themselves always been tailor made. Standardization has recently been brought about by a committee organized by the American Institute of Electrical Engineers and the American Society of Mechanical Engineers, and is recognized as a definite step toward improving the power facilities of the country and at the same time giving more satisfactory service to the public in general.

The six sizes of turbines decided upon by the committee as within the range of the most common of the larger power plant sizes and therefore the most suitable for standardization, run from 11,500 to 60,000 kw in productive capacity. This is sufficient range to provide power for cities from 10,000 to 50,000 population.

With a plant's productive facilities geared to a definite number of turbine sizes, it is expected that many types of stock parts—such as blades—can be turned out in quantity for use in future orders or to be kept in reserve as replacements.

Among the advantages to be gained by standardization are the speeding up of production and facilitating of quicker delivery of equipment to customers than when they had to wait for a tailor-made turbine designed and built to their own specifications. It will also be much easier to provide repairs and to service machinery than before.

MANUFACTURERS' *News*

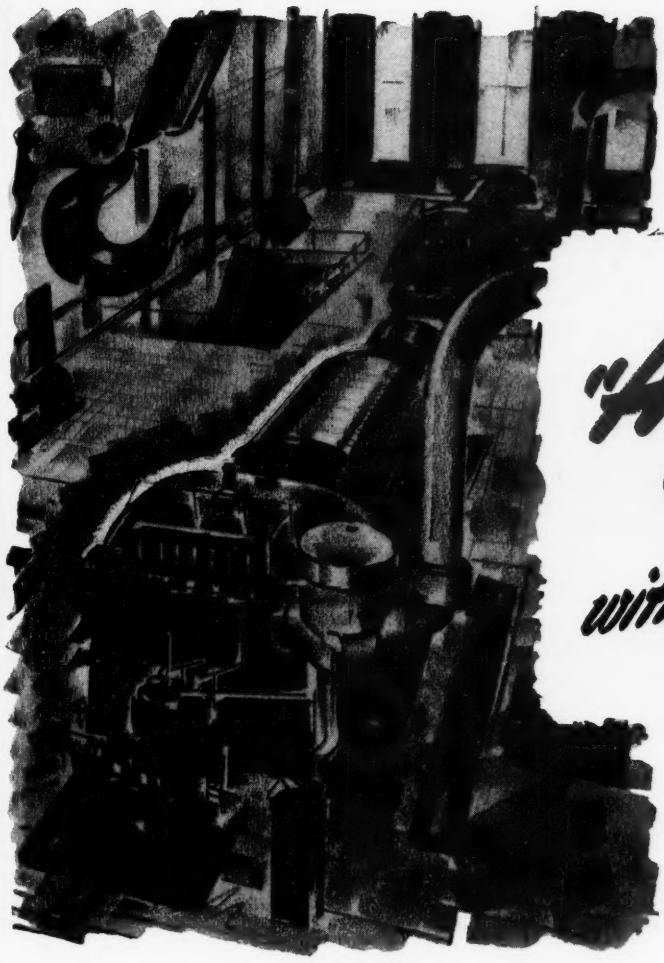
Pittsburgh Equitable Meter Co. Changes Name

PROMPTED BY THE increasing scope of its manufacturing facilities, the name of the Pittsburgh Equitable Meter Co. has been changed to the Rockwell Manufacturing Co., but the directors of the Pittsburgh Equitable Meter Co. will continue as directors of the Rockwell Manufacturing Co. which will continue to have its offices at 400 Lexington Avenue, Pittsburgh 8, Pa.

Col. Willard F. Rockwell, for whom the company is named is Chairman of the Board and President. Serving with him on the Board are J. Frank Drake, Meredyth H. Ewing, Edgar W. Meyers, Henry A. Phillips and Willard F. Rockwell, Jr., all of Pittsburgh, Pa. John L. Merrill, Sven J. Nordstrom and Herbert S. Shuey, of San Francisco; Elisha Walker of New York, and W. F. Crawford of Chicago.

The Pittsburgh Equitable Meter Co. name will be continued as a subsidiary of the Rockwell Manufacturing Co. marketing measuring equipment for water, gasoline, oil and other liquids, manufactured in plants located in Pittsburgh, Brooklyn and Hopewell, N. J.

In addition to the Pittsburgh Equitable Meter Co., the Rockwell Manu-



"Absence of Sludge with Tycol turbine oil"

"Fifteen years without oil change . . .
Oiling system clean at all times . . .
Low maintenance costs . . .
Tycol turbine oils used exclusively..."

— that's how one general superintendent describes the superior qualities of Tycol Turbine Oils. "These qualities are extremely important to us," he added, "and have, of course, resulted in low maintenance costs."

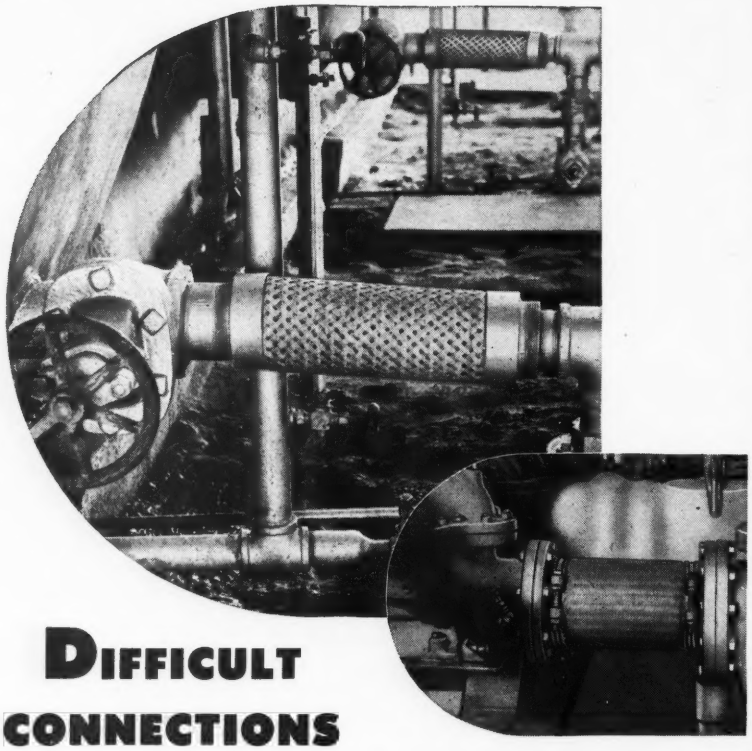
For full details concerning Tycol Turbine Oils, call, write, or wire your nearest Tide Water Associated Office.

LUBRICATION — "ENGINEERED TO FIT THE JOB"

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE - NEW YORK 4, N. Y.



DIFFICULT CONNECTIONS ARE *EASY* WITH REX-WELD!

Here's Rex-Weld, RW-91—the easy, economical solution to your difficult connection problems! For this Flexible Metal Hose is ideal for

- correcting misalignment
- connecting "hard-to-reach" inlets and outlets
- hose lines that must be frequently connected and disconnected
- temporary hookups

RW-91—made in steel and bronze—withstands temperatures to 1200° F and burst pressures to 2700 p.s.i.—depending on I.D. In addition, it's leakproof and is available with helical or annular corrugations, beamed braid or braided braid. Helical sizes range from 3/16" to 4" I.D.—annular sizes from 5/32" to 2" I.D. REX-WELD, RW-91 is ready to go to work for you now! Ask for Bulletin E-144.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

CMH CHICAGO METAL HOSE CORPORATION

MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Illinois

facturing Co. is the parent company of the Merco Nordstrom Valve Co., Oakland, Calif.; Rockwell Machine Co., Hopewell, N. J.; The Edward Valve & Mfg. Co., Inc., East Chicago, Ind.; The Delta Mfg. Co., Milwaukee, Wis.; The V. & O. Press Co., Hudson, N. Y.; The Crescent Machine Co., Leetonia, O.; Rockwell International Corp., New York City; and Monessen Foundry and Machine Co., Monessen, Pa.

Worthington Plans Manufacturing at Holyoke

PLANS ARE NOW complete to turn a large part of the heavy ordnance manufacturing facilities of the Worthington Pump and Machinery Corporation's Plant in Holyoke, Mass., into production of air conditioning and refrigeration equipment of the latest design. Facilities for the operation have been moved there from the corporation's plant in Harrison.

Engineers are concluding designs for a new line of Freon-12 refrigerating compressors. Also to be produced at Holyoke will be a line of air handling equipment including air conditioning units, shower condensers, product coolers, and evaporative coolers in a wide range of sizes and capacities.

One of the most complete test laboratories for refrigeration equipment in the country has been installed. Assembly line methods have been set up in the same shop where 90 mm antiaircraft guns were produced in the early part of the war.

Sales headquarters will also locate in Holyoke. The heavy industrial equipment is still being made in Harrison.

Cochrane Meter Line Acquired by Penn Industrial Instrument Corp.

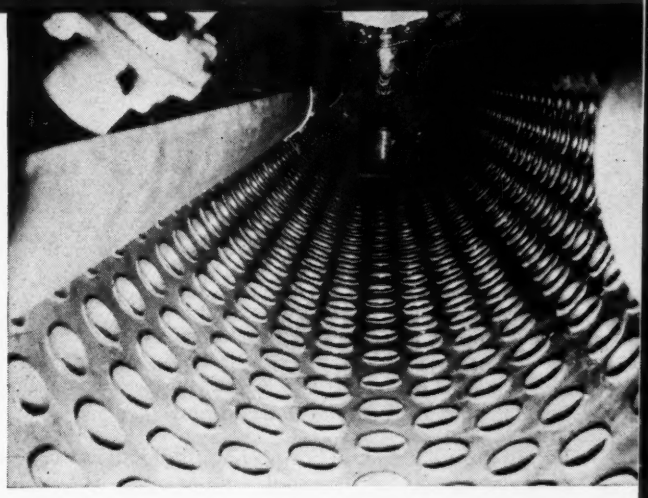
THE FLOW METER DIVISION OF COCHRANE CORP., Philadelphia, Pa., has been purchased by the Penn Industrial Instrument Corp. of Philadelphia which was formed by a group of men whose entire business careers have been devoted to industrial instrumentation.

This new corporation is headed by William C. Bennett, president and general manager with William Melas as vice president and chief engineer and Kenneth C. Markley as vice president and works manager.

Arrangements have been made whereby the Penn Industrial Instrument Corp. will manufacture the present line of Cochrane flow meters exclusively for The Hays Corp. who will market these meters under the name Hays-Cochrane Meters. Penn expects to make early announcement of a line of air-operated controllers for temperature, pressure, flow and level to be marketed directly by Penn through the present Cochrane flow meter representatives with offices in 42 cities in the United States and Canada.

The new corporations plant is at 3116 N. 17th St., Philadelphia, where

DOWELL



full power restored

When the load is heavy and your heat-exchange equipment *must* function at full capacity—that's when Dowell's chemical method of cleaning unwanted scale and sludge from boilers *is most appreciated!*

Power plant engineers looking for a safe, rapid, thorough means of restoring designed operating efficiency are turning more and more to Dowell.

Dowell specialists offer a complete service. They pre-inspect the equipment to be cleaned. They chemically analyze samples of deposits found in *your* plant. And after this careful preparation, they bring with them the proper chemicals and adequate equipment to control completely every stage of the treatment—to insure effective removal of the insulating deposits.

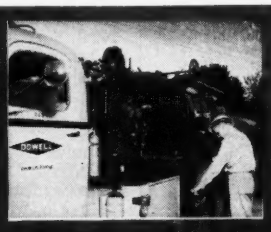
For complete details, call the nearest Dowell office for a free estimate. Ask for your copy of "More Power to America's Industry"—new color booklet which explains and illustrates Dowell's thorough chemical cleaning service.

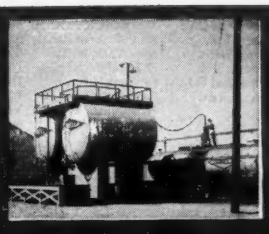
DOWELL INCORPORATED • TULSA 3, OKLAHOMA

Subsidiary of The Dow Chemical Company

New York • Philadelphia • Baltimore • Buffalo • Cincinnati • Cleveland
Chicago • Detroit • St. Louis • Houston • Kansas City • Wichita
Mt. Pleasant, Michigan • Salem, Illinois
Long Beach, Casper: Dowell Affiliate—International Cementers, Inc.

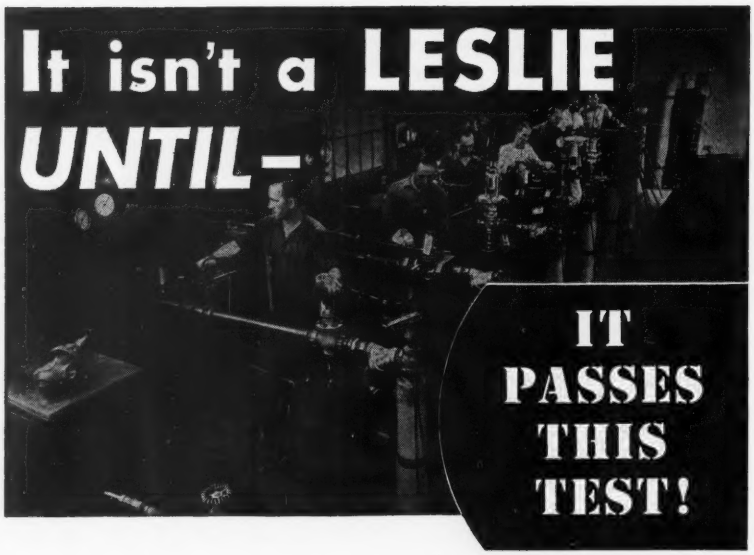
SPECIALISTS IN CHEMICAL CLEANING SERVICE





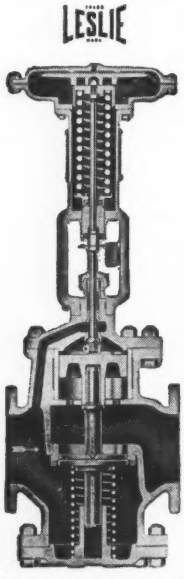
DOWELL

FOR INDUSTRIAL CHEMICAL SERVICE



Built into every step in the manufacture of every LESLIE Regulator is an almost endless chain of rigid control, inspection and test operations, starting with control of the molten metal itself and following right on through to the individual finished part.

But, that is not enough! For *no* LESLIE Regulator has earned the right to go out on a job and render long, trouble-free operation until it has passed completely assembled through the Test Department shown above.



LESLIE Class D-1, Single-Seated, Balanced Diaphragm Regulating Valve with Type PR Control Pilot.

Here, each Regulator is placed in a test steam line at actual working pressures and put through its paces by a battery of skilled test engineers—another in a long series of reasons why the name LESLIE is often considered synonymous with low maintenance cost—why LESLIE Regulators stay on in service year after year without replacement. If this is the type of performance you are seeking in a Regulator, why not consider a LESLIE?

YOUR COPY of LESLIE Catalog of Engineering Data covering our complete line of Regulators, Controllers, Strainers and Whistles, will be sent on request—no charge—send for it today.

LESLIE CO.
257 Grant Avenue • Lyndhurst, N. J.

Look for "LESLIE Regulators" in your classified telephone directory in the following cities where LESLIE factory trained engineers are located.

Baltimore, Md.	Kansas City, Mo.	Rutherford, N. J.
Boston, Mass.	Los Angeles, Cal.	San Antonio, Tex.
Bridgeport, Conn.	Louisville, Ky.	San Francisco, Cal.
Chicago, Ill.	Milwaukee, Wis.	Savannah, Ga.
Cleveland, Ohio	Montreal, Que., Can.	Seattle, Wash.
Dallas, Tex.	New Orleans, La.	St. Louis, Mo.
Detroit, Mich.	New York, N. Y.	Syracuse, N. Y.
Fremont, Neb.	Philadelphia, Pa.	Toronto, Ont., Can.
Greenville, S. C.	Pittsburgh, Pa.	Troy, N. Y.
Houston, Tex.	Portland, Ore.	Tulsa, Okla.
	Providence, R. I.	Vancouver, B.C., Can.
	Richmond, Va.	Wilkes-Barre, Pa.
	Rochester, N. Y.	Youngstown, Ohio

ESTABLISHED 1900
LESLIE CO.
PRESSURE REDUCING VALVES · PUMP GOVERNORS · PRESSURE CONTROLLERS
TEMPERATURE REGULATORS · SELF CLEANING STRAINERS · LESLIE-TYFON WHISTLES

engineering, development and production departments and general offices are located.

Among the directors are W. B. Heinz and F. W. Henkins, both of whom have been connected with the manufacture and design of Cochrane instruments for a number of years.

Morse Boulger Purchases Chem-Feeds, Inc.

MORSE BOULGER DESTRUCTOR CO., New York 17, N. Y., has announced the purchase of Chem-Feeds, Inc., Providence, R. I., and will carry on the business as the Chemical Feeders Division of Morse Boulger Destructor co.

Jeff Corydon II, who founded Chem-Feeds, Inc., will be head of the new division of Morse Boulger. The company's principal product is the Vari-Feeders whose outstanding feature is the control by speed, which enables it to pump at speeds up to 400 strokes per minute and permits the operator to control more accurately the proportioning than when a low stroke feeder is used.

The equipment is applicable to the feeding of any wet chemical and against pressures where required.

C. H. Wheeler Mfg. Co. Personnel

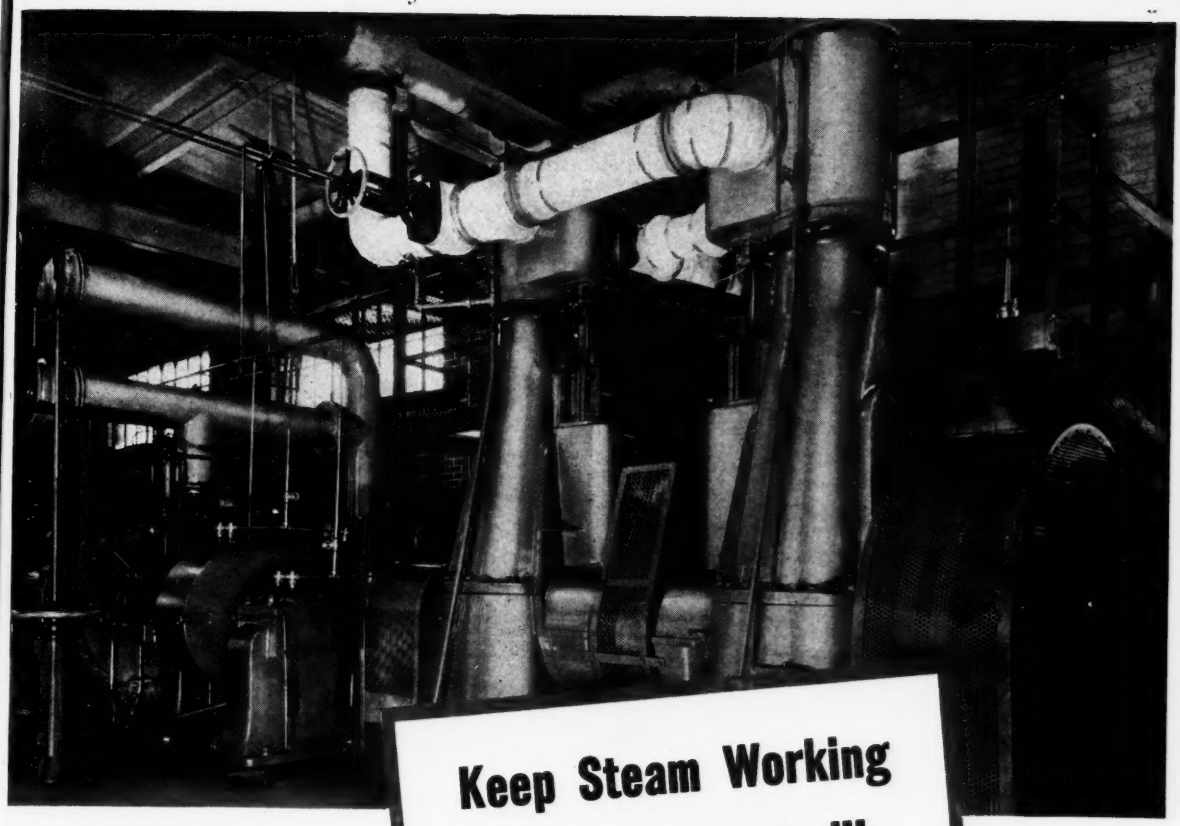
ANNOUNCEMENT HAS COME FROM the C. H. Wheeler Mfg. Co., Philadelphia, Pa., that the executive officers of the company now consist of C. M. Brown, chairman of the Board; P. S. Lyon, president and general manager; F. L. Yetter, vice president; L. A. Droescher, vice president; J. J. Bolton, Jr., vice president, and J. S. Gabel, secretary and treasurer.

The new president and general manager, P. S. Lyon is a newcomer with the company, but he is well known in power plant and general industrial plant circles. Until recently, he was president and general manager of the Cochrane Corp. of Philadelphia, and resigned when the company ownership changed. He has also been associated with Hall Electric Heating Co. of Philadelphia, as chief engineer, and at one time headed the engineering section of the Air Conditioning Dept. of the General Electric Co. in New York City.

F. Leon Yetter, now a vice president, has been with C. H. Wheeler Mfg. Co. for thirty years. He was formerly employed at Moulton Engineering Co., New Haven, Conn. and Portland, Maine, Alberger Pump and Condenser Co., Newburgh, N. Y., and De Laval Steam Turbine Co. of Trenton, N. J.

Leroy A. Droescher, now a vice-president, has been with C. H. Wheeler Mfg. Co. 23 years and was formerly Test Engineer at the U. S. Naval Engineering Experiment Station, Annapolis, Md.

James J. Bolton, Jr., now a vice-president, has been with C. H. Wheeler Mfg. Co. for seven years. He was formerly employed by the Pennsylvania Crusher Co., The Automatic Drive and



TROY
ENGBERG

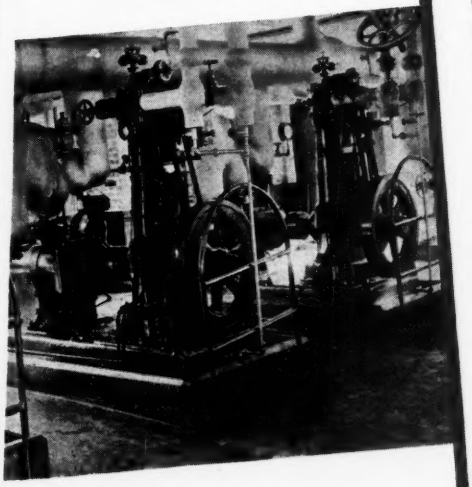
Keep Steam Working Until "Exhausted"

Power wasted by passing live steam through a pressure reducer makes your heating cost higher than it should be. This lost power can be recovered and a saving effected by first using the steam to drive a Troy-Engberg Steam Engine.

The energy thus converted can be utilized to drive a generator, stoker, blower, compressor or other equipment. After being used in this manner, the steam at proper pressure goes on to do its principal job of heating.

Savings in power costs—either direct or through fuel economies—quickly repay your entire investment sometimes in as little as one year.

If you use low-pressure steam in your plant for heating or processing, investigate the possibility of using Troy-Engberg Steam Engines to provide By-Product Power.



TROY ENGINE & MACHINE CO.

885 RAILROAD AVENUE — Established 1870 — TROY, PENNSYLVANIA

Transmission Co., American Engineering Co. and M. L. Bayard & Co.

J. S. Gabel has been with C. H. Wheeler Mfg. Co. for 28 years, and for the past 9 years has been secretary and treasurer.

Bowser to Manufacture Torrington Lubricators

FRED S. EHRMAN, general sales manager of Bowser, Inc., Fort Wayne, Ind., has announced that the complete inventory of parts and the exclusive manufacturing rights of Torrington Lubricators have been acquired by Bowser from the Torrington Mfg. Co., Torrington, Conn.

These Torrington lubricators will be manufactured at the Fort Wayne plant and distributed through the Bowser system of sales and service branches and warehouses, supplementing their regular line of lubrication equipment. Replacement parts and service on Torrington lubricators now installed are available through Bowser branches, which are located in all important industrial centers in the United States and Canada.

Announcement has been made by Sarco Co., Inc., of 475 Fifth Ave., New York 17, N. Y., that it has opened a Washington office at 1129 Vermont Ave., N.W., Washington 5, D. C. Major H. F. Collins, formerly of the U. S. Army Engineers will be in charge of the office having represented the company in eastern Pennsylvania for a number of years.

RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

Admiralty Coal

Genuine New River Smokeless, Beckley or Sewell seam from Raleigh County, W. Va., C. & O. and Virginian Railroads.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

ANTHRACITE — Hazle Brook Premium . . . Raven Run

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

Announcement has been made by the Askania Regulator Co. of the opening of the factory branch office to handle the company's engineering, sales and service at 818 Bessemer Building, 104 Sixth St., Pittsburgh 22, Pa. Management of the office will be in charge of E. R. Engstrom who has been with the home office since the beginning of the company. C. E. Hague, who is in charge of Askania Sales in Cleveland, is being established as sales manager of the Pittsburgh and Cleveland districts.

Removal of its Chicago District Office from its former location to 120 S. LaSalle St., Room 1951, has been announced by Fuller Co. of Catasauqua, Pa.

MANUFACTURERS' *Personals*

Edward Valves, Inc. of East Chicago, Ind., announces through its director of research, L. H. Carr, the appointment of E. B. Pool as a research investigator to conduct a new type of valve research work. Mr. Pool was for ten years a mechanical and experimental engineer with Chrysler Corp., and will specialize in stress and strain experiments and pioneering investigations in flow characteristics and pressure drop in addition to other mechanical and metallurgical research work.

Jack Ellsworth has been appointed to take charge of the newly opened office of Tube Turns, Inc. in Detroit at 713 Ford Building. His territory will include Michigan, Northeastern Ohio, North Illinois and Indiana except Whiting and East Chicago. Mr. Ellsworth was formerly assistant district manager of the Midwest territory with headquarters in Chicago.

Lachlan W. MacLean has recently been appointed Boston Sales office manager for the Dampney Co. of America, Hyde Park, Boston, Mass. Mr. MacLean takes over the service of the New England area and will give practical and technical assistance to New England users of Apexior and Thur-Ma-Lox protective coatings. He has had ten years of executive field experience with the company in the Philadelphia and New York City districts.

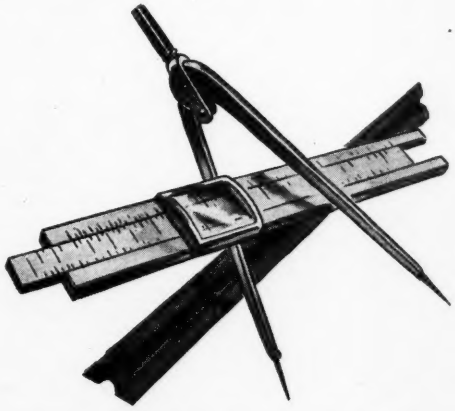
J. A. McPeak and R. P. Farrell, formerly associated with France Packing Co. have recently become financially interested in the Harper Packing Co. of Chester, Pa. Both men have had a wide experience in the design and manufacture of metal packings and are in a position to furnish packing for all types of engines and compressors. Mr. McPeak is vice-president and general manager of the company and Mr. Farrell is secretary and treasurer.

Ever Figure What a 765 hp Motor Throws Off in Heat?

Our Navy Did... on fleet tugs down in the tropics, where engine room temperatures were running high as 140°F! In 25 by 30 ft of space, that's like having 140, thousand-watt radiant heaters "raising blisters" on you all at one time!

Here's How Navy Figured: To get 765 shaft hp out of 94% efficient propulsion motors, of which there are four aboard, they were putting in about 812 hp of electrical energy. Or, 47 hp went in that didn't come out of the shaft, but escaped through the frame. This ran about 35 kw heat per motor.

Well, Our Temperatures Began To Rise when Navy laid down its 'specs'. "Design a marine water-cooled motor—make it fit into the floor space of your open drip-proof type—no major changes in ship design. Make it extra-dependable, as fireproof as practicable".



We Measured, and figured, and made designs—used a new, toxic gas-free Glass Melamine insulation that required extensive changes in design and fabrication. We put special air passages inside the motor—yet kept accessibility. We saved 25% space over our previous commercial marine design by figuring a special shape cooler—without cutting down cooler efficiency.

Then We Made Those Motors Shock-Proof — by cutting out all cast iron, re-designing structural members for greater strength, resorting to modern, proven fabrication throughout. Result: A new kind of water-cooled motor that put a "tough" Navy job on ice, and also proved a point! A 1999

There's a Point to this story: Every time Allis-Chalmers engineering discovers new ways of solving *special* motor problems, like this one, it also learns how to build better *standard* motors for you! Watch for these new and better motors from A-C. ALLIS-CHALMERS, MILWAUKEE 1, WIS.

Wait 'til you see the NEW

ALLIS-CHALMERS MOTORS!

HEAR THE BOSTON SYMPHONY: *Every Saturday Evening, American Broadcasting Co.*

Jack Green has recently been appointed by Tube Turns, Inc. of Louisville, Ky., as sales manager of the welding fittings division. Mr. Green joined the company in 1941 when he was stationed in Chicago as district manager, but since June 1943 he has been the division's assistant sales manager. He is succeeded as assistant sales manager of the welding fittings division by Tom Pike who has been with the company since 1940 and until recently was district manager in charge of the West Coast territory.

Crocker-Wheeler Division of Joshua Hendy Iron Works, Ampere, N. J., has appointed I. C. Smith to the position of chief engineer of the company. Mr. Smith joined Crocker-Wheeler in 1942 as a designer of direct-current motor and generator equipment and has spent many years with the Elliott Co. of Ridgway, Pa., where he was in charge of d-c design. He also had a background of experience with Westinghouse.

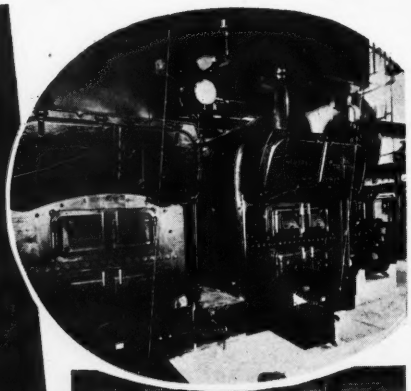
Davis Engineering Corp., Elizabeth, N. J., has announced the appointment of C. Edward Bernard as manager of agency sales. Mr. Bernard joined the Davis Engineering Corp. in 1945 after many years of association with the Worthington Pump & Machinery Corp. as sales engineer and feedwater heater specialist on steam power plant equipment.

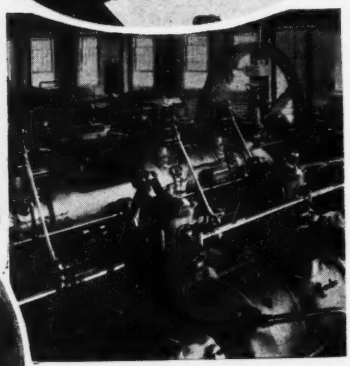
HAERING GLUCOSATES

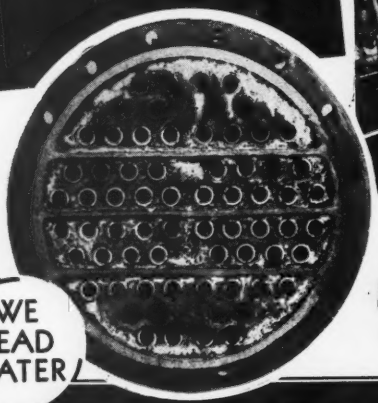
over a period of years have controlled

Corrossion, Scale and Algae

in INDUSTRIAL PLANTS







WE READ WATER

Write on your letterhead for the latest "H-O-H Water Studies"

D. W. HAERING & CO., Inc.

GENERAL OFFICES:

205 West Wacker Drive, Chicago 6, Illinois

Agents to handle industrial sales and services for Leslie Co. Lyndhurst, N. J., have been selected as follows: Walz and Krenzer, Inc., Rochester, N. Y., Mid-western New York; Gulf Engineering Co., Inc., Savannah, Ga., Southeastern Georgia; Robinson Electric Co., Ltd., Vancouver, B. C., Canada, British Columbia.

Iron Fireman Mfg. Co. has recently made the following appointments of district representatives in the midwest and central division: L. N. Zimmerman, Howard B. Weeks and Gale B. Robinson. Mr. Zimmerman will cover southeastern Michigan and northwestern Ohio with headquarters in Detroit. Mr. Weeks will have headquarters in Decatur, Ill. and Mr. Robinson rejoins the Iron Fireman organization after army provost marshall service and will have headquarters in Connersville, Indiana.

Johns-Manville Corp. through its vice president L. M. Cassidy has made the following announcement of appointments in the company's sales organization: J. A. O'Brien of White Plains, N. Y., vice president of Johns-Manville Sales Corp. has been appointed manager of the power products and industrial department. He will also serve as a member of the Officers Board. H. R. Berlin of Scarsdale, N. Y. has been elected vice-president of the Johns-Manville Sales Corp. and is appointed manager of the building materials and general department of the company. He will also serve as a member of the Officers Board. C. G. Dandrow of White Plains, N. Y., has been elected a vice-president of the Johns-Manville Sales Corp. and is appointed general sales manager of the power products and industrial department.

Frank R. Markley, formerly manager of the company's industrial products department, has been appointed general sales manager of the Sun Oil Co., and will serve as assistant to Samuel B. Eckert in the conduct of all sales activities. Ray H. Anders, who has been assistant manager of the department since September 15, 1944, has been appointed to succeed Mr. Markley as manager of the industrial products department. Appointment was also announced of Maximilian H. Leister as general manager of Sun's motor products department. He has been acting general sales manager since 1942 and will devote his full time to supervising the sale of all motor products and the operation of service stations and all advertising.

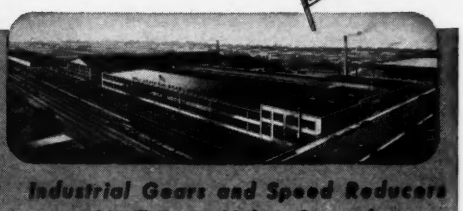
American Locomotive Co. has recently announced the appointment of three representatives in the St. Louis, Mo. district. George B. Powell is now assistant to N. C. Naylor, vice-president, who makes his headquarters in Chicago; William F. Lewis was named district sales manager in charge of sales; and Charles C. Davis was appointed sales representative in the same city.

Westinghouse Electric Corp. has appointed W. E. Lee, formerly of Los Angeles and a sales engineer in the mining industries for the corporation,

One Name-ALL TYPES

In fact, Phillie Gear was one of the true Pioneers in the design and manufacture of *Speed Reducers, for Industrial Purposes.*

For every conceivable type of Industrial Drive, there is a correct type of Philadelphia Speed Reducer—and by choosing Philadelphia Reducers, you not only secure *Quality Products,* but you place the responsibility for their construction and operation with one *manufacturer* (a point worthy of serious consideration).



Philadelphia GEAR WORKS INCORPORATED

ERIE AVE. AND G ST., PHILADELPHIA 34, PA. NEW YORK · PITTSBURGH · CHICAGO

IN CANADA: WILLIAM & J. G. GREEY LIMITED, TORONTO.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

There is NO Substitute for a . . .

QUIMBY SCREW PUMP

New! QUIMBY FLOATING LINK* An exclusive QUIMBY feature: Permits Higher Pressures—Higher Speeds—Lower Viscosities. A revolutionary new feature that will vastly increase the efficiency, temperature range, and flexibility of the screw pump. Write for complete information.

*PATENT PENDING

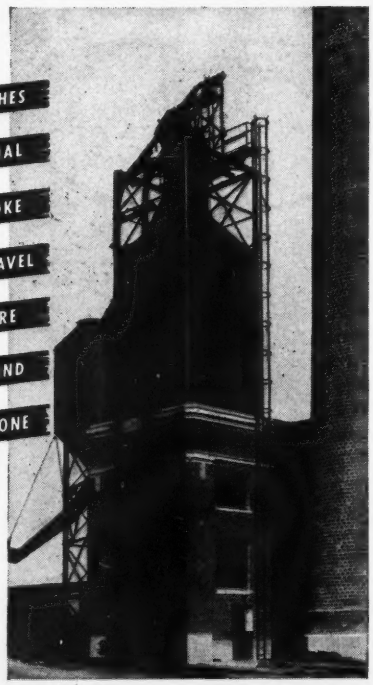
H. K. PORTER COMPANY, Inc.
PITTSBURGH 22, PENNSYLVANIA
Quimby Pump Division
NEWARK 5, N. J.
District Offices in Principal Cities

QUIMBY PUMPS
The KNOW HOW of Pumping since 1894

DO YOU handle any of these materials in bulk?

ASHES
COAL
COKE
GRAVEL
ORE
SAND
STONE

• Beaumont Skip Hoists are ideal for high lifts and for handling heavy, abrasive and bulky materials. One or two buckets operating in heavy I-beam tracks, either counterweighted, un-counterweighted or balanced. Automatic and semi-automatic operation. All capacities and sizes. Write outlining your requirements for our engineer's recommendations and quotation.



Heavy I-beam Tracks
In the installation illustrated, the skip hoist handles both coal and ashes alternately, in same bucket, and discharges to either coal or ash bunkers.

BEAUMONT BIRCH COMPANY
1503 RACE STREET PHILADELPHIA 2, PA.
DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS

as manager of the company's Phoenix, Ariz. office.

Roland A. Sherwood has recently been appointed assistant to Robert B. McColl, President of the American Locomotive Co., and will make his headquarters at the company's general offices at 30 Church St., New York.

Roto Division of Elliott Company has announced that C. L. Gould, who was previously in charge of the New Jersey district, has been placed in charge of the new San Francisco office of the company which is located at 526 Folsom St. Mr. Gould has been with the company for over ten years.

Carl A. Marshall has recently been appointed as fuel engineer to assist in the expanded program being carried out by the Fairmont Coal Bureau, New York Office. Mr. Marshall has recently returned from sixteen months in the European Theater where he served as Chief of the Petroleum and Fuel Branch at the United Kingdom Base.

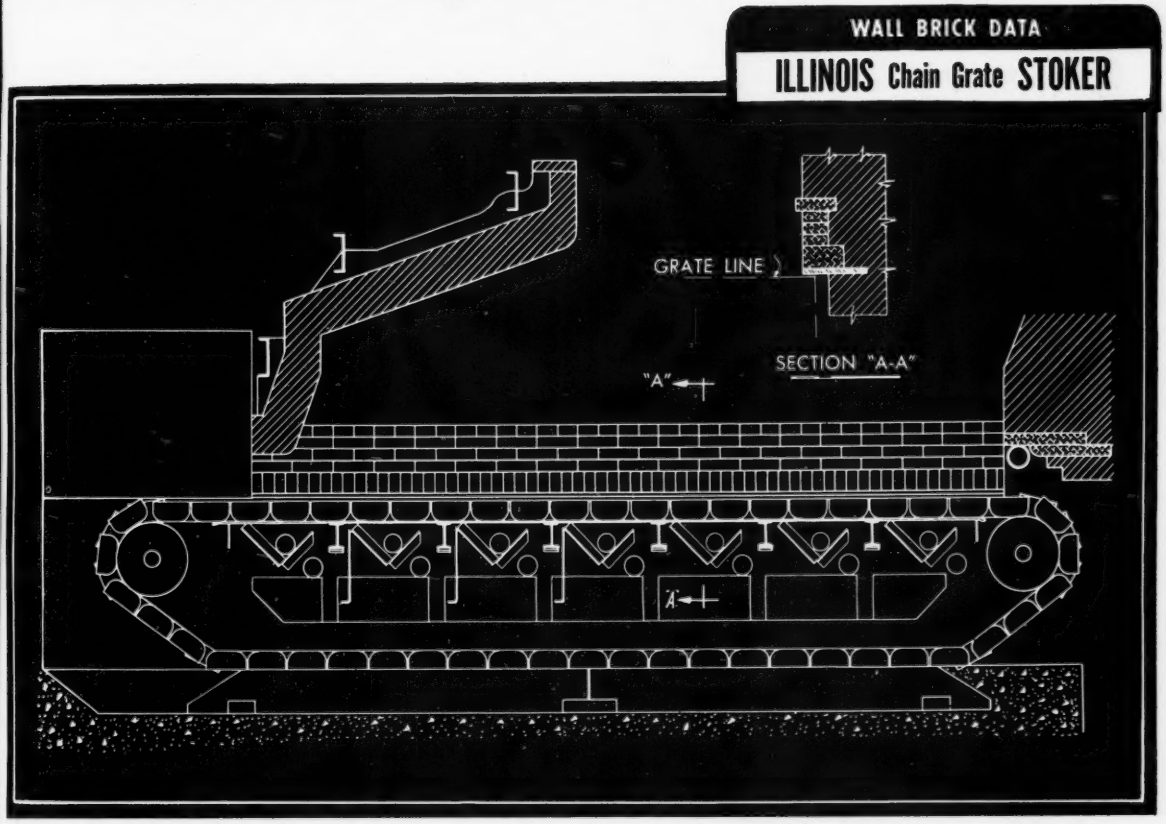
Captain Vincent H. Godfrey has recently returned to Page Steel and Wire Division of American Chain & Cable Co., Inc., as sales engineer with headquarters at Monessen, Pa. Mr. Godfrey, who is a graduate of Annapolis and served in the Navy for 21 years, was with the Page Steel and Wire Division for 2 years prior to reentering the Naval Service in 1941.

Cutler-Hammer, Inc., has recently appointed John L. Defandorf as general engineering supervisor over Rubber Mill, Synchronous Motor, Valve Control, Public Works, Short Orders, Textile, Paper and Printing Equipment divisions for the company. Mr. Defandorf was graduated from Johns Hopkins University in 1917 and shortly after joined the Cutler-Hammer organization as a student engineer. In his various capacities with the company since then, his experiences have covered almost every phase of the industrial activity.

Gil Moore, 4031 Goodwin Avenue, Los Angeles, Calif., has been appointed as representative for the Warren Steam Pump Co., Inc., of Warren, Mass., to handle both reciprocating and centrifugal types of pumps. His territory will include southern California south of and including the counties of San Luis Obispo, Kern and San Bernardino, the State of Arizona and Clark County in Nevada.

Bingham H. Van Dyke has recently been appointed manager of the New Products Department of the Elliott Co., Jeannette, Pa. He previously was assistant to the director of Research and Development and prior to coming to the Elliott Co. was associated with the War Production Board where he was deputy chief of the Heat Exchanger and Pressure Vessel Branch.

A Furnace Program that wins approval



Illustrated above is a well engineered installation of CARBOFRAX silicon carbide brick in an Illinois Chain Grate Stoker. The height of the lining may vary with operating conditions, but the use of a CARBOFRAX lining constitutes a program which is bound to win approval.

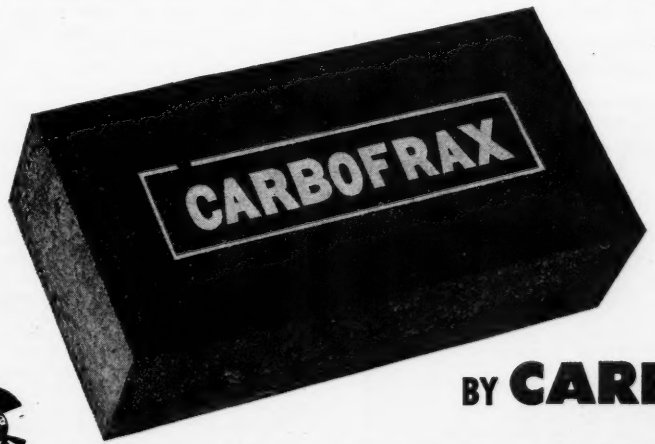
There are countless instances where the life of a CARBOFRAX lining has been carefully investigated and compared. Reports of 10 or more years of service are not unusual. The examination never fails to prove the longer life which a CARBOFRAX lining gives, and the steady punishment it can always take.

With a CARBOFRAX setting you can usually count on greater steaming capacity, too. The super refractory quality of CARBOFRAX brick discourages large clinker formations, and the complete grate area is more apt to be utilized. The long life also contributes to increased production since outages for lining repairs are drastically reduced, compared to the use of ordinary refractories.

The fuel figures also look good when CARBOFRAX linings are used. Combustion is naturally improved when you get a cleaner, more active fire. And that means fuel savings.

CARBOFRAX brick will prove itself in the clinker zone of any stoker or furnace. Their high refractoriness, great strength, and mechanical and flame resistance never fail to show up to operating advantage. Make it a point to investigate their benefits soon.

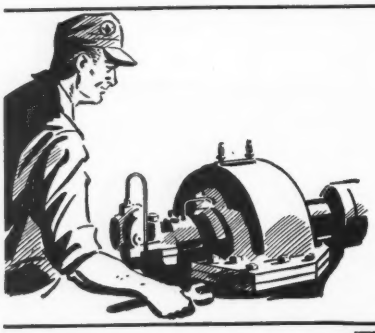
In the meantime we'll gladly send you a booklet containing complete engineering data on our super refractories, if you write Dept. H36, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



BY CARBORUNDUM
TRADE MARK

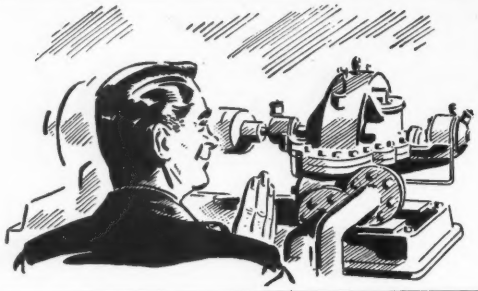
"Carborundum" and "Carbofrax" are registered trademarks of, and indicate manufacture by, The Carborundum Company

3 STEPS TO FEWER PACKING REPLACEMENTS



1. Make up your mind to put an end to power-wasting leaks and frequent time-wasting replacements.

2. Ask the Belmont distributor to show you the handy PACKING RECOMMENDATION CHARTS.



3. Standardize on the right Belmont packing at every point.

Belmont Distributors are located in every large industrial center, ready to serve you promptly from local stocks. Get the PACKING RECOMMENDATION CHARTS from the one nearest you — or send the coupon to us.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

on the blue-and-orange box

THE BELMONT PACKING AND RUBBER COMPANY
Butler & Sepviva Streets, Philadelphia 37, Pa.

Gentlemen: Please send PACKING RECOMMENDATION CHARTS for the services checked:

☐Steam . . . ☐Hot Water . . . ☐Cold Water . . . ☐Brine . . . ☐Ammonia . . .
☐Acids & Caustics . . . ☐Air . . . ☐Gas . . . ☐Oil . . . ☐Gasoline . . .
☐Asphaltic & Tar Products . . .

Name.....

Company.....

Address.....

New ENGINEERING BOOKS

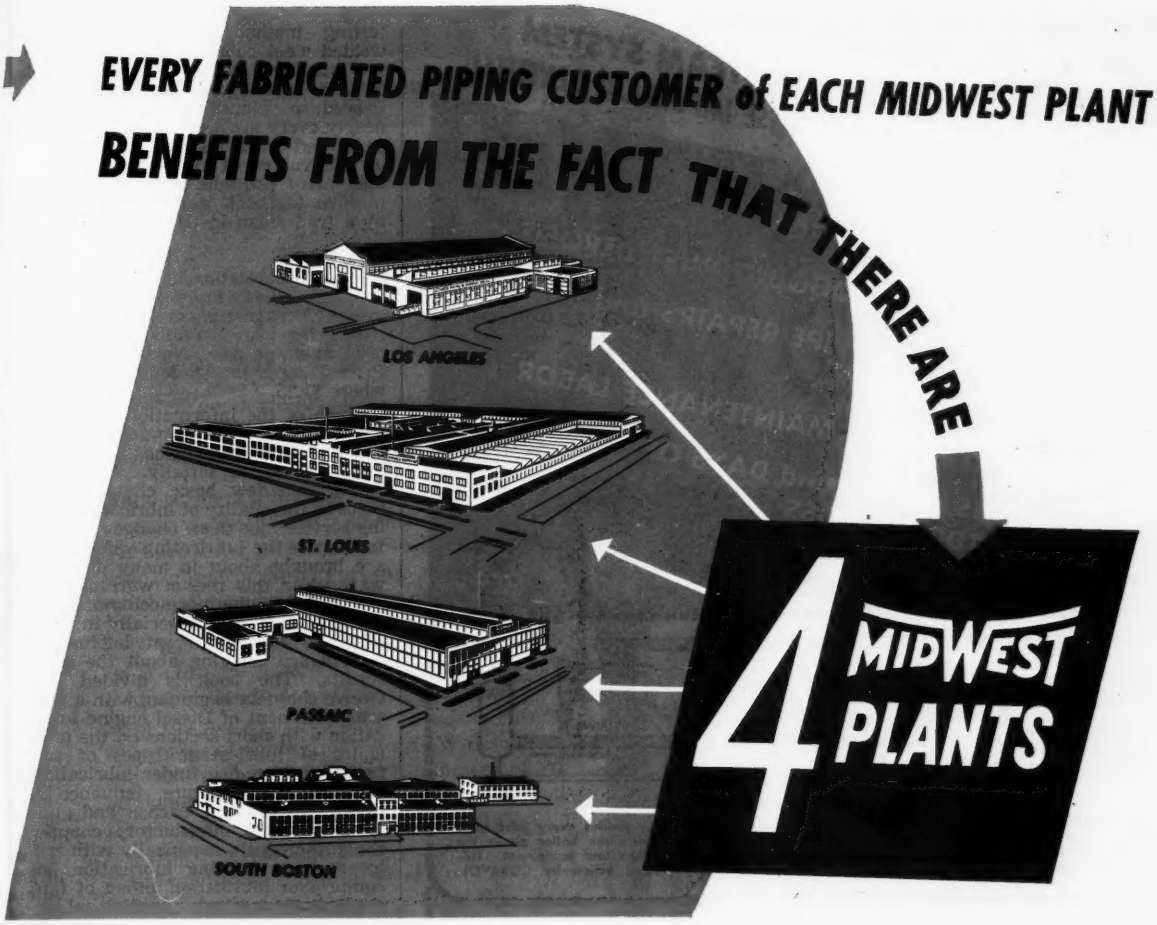
Systems of Weights and Measures by Walter R. Ingalls. Copyright 1945; 5½ by 8½ in.; 51 pages; paper bound; published by the American Institute of Weights and Measures, 33 Rector Street, New York 6, N. Y. Price $1.00.

As president of the American Institute of Weights and Measures, the author of this book has for years made a study of weights and measures as used in modern science and industries in all countries of the world. He states that the only weights and measures that are of any present international interest are those of the English and French systems. Survivals of native systems in the Orient and elsewhere are often important but certainly not international. It has been thought by the author worth while to answer the recrudescence of prometric propaganda, which is strangely persistent, both in Great Britain and in the United States. In the introduction a summary is given of reasons for changing systems of weights and measures with particular attention given to the adoption of the metric system by some leading nations and rejection by others. It is stated that nowhere has voluntary use of the metric system been complete, the extent of its voluntary use being little beyond the laboratories of chemical and physical science. Other sections of the book deal with the real advantages of the metric system and the disputed claims, the organizations and individuals who are prominent in promoting the use of the metric system, a history of its use in the United States, a summary of facts in respect of the metric system and the changes that would necessarily have to take place by the substitution of the metric for the English system.

Procedure Handbook of Arc Welding Design and Practice, Eighth Edition; prepared and published by Lincoln Electric Co., Cleveland 1, Ohio; 6 by 9 in.; 1300 pages; semi-flexible cloth binding; copyright 1945. Price $1.50 in U. S. A., $2.00 elsewhere.

The first edition of this handbook was published in 1933 since which time the welding industry has found that the type of information printed in the book of extreme value and the progress in the art of arc welding has been so rapid that each of the succeeding editions have represented not only revisions but enlargements of the preceding edition. This eighth edition is no exception in that respect but because of developments during the war, revisions and enlargements have been greater than in previous editions. This Handbook has been prepared to guide the executive, designer, engineer, shop supervisor and welder in the use of arc welding for minimum costs and maximum quality in post-war enterprises. The Handbook is divided into eight parts and treats comprehensively every imaginable phase of the arc welding art from descriptions of various welding methods through techniques, costs,

EVERY FABRICATED PIPING CUSTOMER of EACH MIDWEST PLANT BENEFITS FROM THE FACT THAT THERE ARE



Strategically located in various parts of the country, all of the four Midwest plants are of definite benefit to every Midwest customer.

Undoubtedly the most important advantage is the better piping that results from the continuous exchange of information and experience between the four plants. For example, if Passaic develops a new and valuable technique or method, the information is made available at once to St. Louis, Los Angeles, and South Boston. When Los Angeles finds a better way to control grain size in forged lap joints, the other plants are immediately informed. Regardless of which plant fabricates your piping, you get the benefit of the combined experience of all four plants.

Other advantages are greater flexibility in meeting delivery requirements . . . a better understanding of regional conditions . . . source of supply close to the job.

Midwest is logically your first source of piping—whether you want a simple bend, a welded header, or a complete and complex piping job for a large plant fabricated and erected with undivided responsibility.

MIDWEST PIPING & SUPPLY COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass. • Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Mayo Bldg. • Atlanta 3—Red Rock Bldg. • South Boston 27—426 First St.

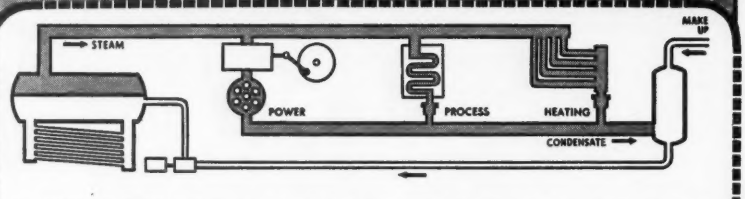
4 PLANTS ARE BETTER THAN 1

PIPING FABRICATORS AND CONTRACTORS

LINES CORAVOL BOILER

IN YOUR STEAM SYSTEM GIVES YOU THESE IMPORTANT BENEFITS!

- PREVENTS CORROSION
- CLEANS OUT CLOGGING RUST DEPOSITS
- SAVES COSTLY PIPE REPAIRS and REPLACEMENTS
- SAVES COSTLY MAINTENANCE LABOR
- SAVES HOURS and DAYS OF SHUTDOWN LOSS



The CORAVOL ZONE—indicated by the shaded area in the diagram—includes every part of a steam system not accessible to boiler feed water treatment. It includes the boiler above the water line, steam lines, condensate return lines, radiators, valves, traps and equipment. This zone can now be reached and protected against rust and corrosive action—by CORAVOL.

CORAVOL IS PART OF A COMPLETE TECHNICAL SERVICE WHICH PROVIDES SPECIAL FORMULAS OF TREATMENT FOR:

Boiler Feed Water . . . Hot Water Supply . . . Refrigerating Brine . . . Cooling and Condenser Water . . . Rapid Scale Removal . . . Coagulation . . . Algae Control

CORAVOL protects lines; increases effectiveness of heat transfer surfaces; restores original capacity of lines and the operating efficiency of valves and traps.

Not a boiler feed water treatment, **CORAVOL** is designed expressly for use in steam systems. Because **CORAVOL** volatilizes and condenses with the steam, it circulates thruout your entire steam system and protects *all* zones from corrosive attack.

For 9 years, **CORAVOL** has proved its value in hundreds of heating and steam power plants in more than 20 different industries.

Mail the coupon TODAY for complete FREE data about the **CORAVOL** process.

MAIL TODAY

WESTERN CHEMICAL COMPANY
715 Washington Street — Kansas City 6, Missouri

Without obligation to me, please send complete data on the CORAVOL Process

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

CITY AND STATE_____ (6)

testing methods, weldable metals, welded steel construction, design for arc welding and typical applications of arc welding in manufacturing. Procedure Handbook will answer nearly every arc welding problem encountered in industry. It combines in one volume a ready reference, a manual of procedure and a comprehensive textbook readily understood by a tradesman in the art.

Diesel Lubrication by A. B. Newell, copyright 1944; first edition, 4½ by 6 in.; 136 pages; paper binding; published by Diesel Publications, Inc., 192 Lexington Ave., New York, N. Y. Price $1.00 in the United States, elsewhere $1.25.

Much of the information contained in this book comes from articles, published in the magazine Motorship, which appeared serially. The book shows that few basic changes take place in the quality of lubrication during service, but those changes tending to destroy the lubricating value of oil are brought about in many different ways. For this reason warnings are given against the more commonly encountered troubles, especially in those instances where different detrimental factors are bringing about the same results. The book is divided into twelve chapters beginning with a general treatment of Diesel engine lubrication with short sections on the principles of lubrication, types of surfaces lubricated, cylinder lubrication, effects of temperature, influence of pressure, oxidation, carbon and gum. Following this introductory chapter, the author deals specifically with topics such as bearing lubrication, air compressor lubrication, effect of fuel, application methods, special oil requirements, testing lubricants, purification, filters, centrifugal purifiers and Diesel engine bearings. Diesel operators will find this a very helpful book for keeping their engines in tip top running condition.

Under the title "The Golden Book of American Industry" the Industrial Publishing Co., Palisades, N. J., has published the first history of the contribution of American industry to the war effort. The book, 6 by 9½ in., in hard binding has 529 pages, is well illustrated and gives the war history of nearly 500 of the leading American industries which were awarded the Army-Navy "E" or the Maritime Commission "M." Difficulties encountered in converting to war basis, measures resorted to and problems of expansion of manufacturing facilities, equipment and personnel involved in the vast increase in production, are recounted in concise statements regarding each of the companies treated in the book. In these short stories, industry's eagerness to serve the nation in time of crisis is a universal note and along with it are frequent glimpses of the genius that has made America great. The battle on the home front, though not summarized, is well told in the short sketches about individual companies indicating the shoulder-to-shoulder stand of company owners, managers, engineers, scientists and artisans of all kinds to present a solid front in the winning of the war.

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There are good, sound *reasons* why coal- and ash-handling problems are so frequently *solved at a saving* when Gifford-Wood is called in at the start.

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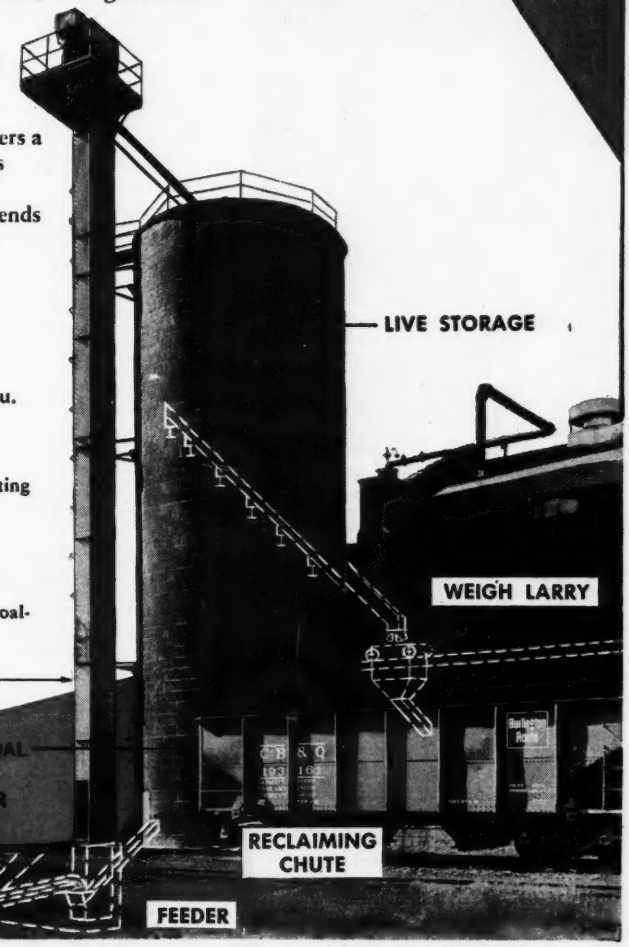
G-W has been specializing in this *complete service* for 130 years. That experience—evident in hundreds of G-W installations—saves you money, too. And G-W *advice* covers a wide range of applications—for G-W designs and builds material-handling equipment of *all* popular types. The system G-W recommends for you is based on one thing: your needs, as revealed by a thorough study of your plant conditions. Gifford-Wood Co., 420 Lexington Ave., New York 17, N. Y.; 565 W. Washington St., Chicago 6, Ill.—Factory: Hudson, N. Y.
Let a G-W engineer call and consult with you. Just write Dept. E.

Illustrated is an installation of *standard* G-W equipment co-ordinated into a handling system meeting *specific* requirements—the moving of coal, mechanically, from track hopper to storage, thence to boiler room. Your problem may be similar—or it may call for special equipment, which G-W also designs and builds. Either way, there are good reasons why a G-W system may give you greater coal-handling efficiency at lower cost.



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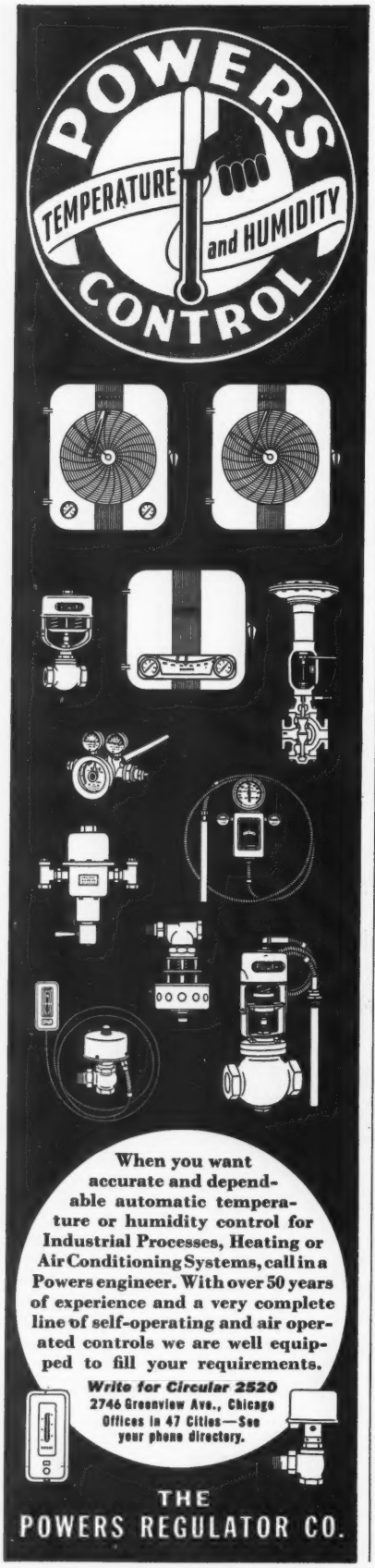
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HELPFUL BULLETINS

(Continued from page 36)

65 **Practical Instruction in Arc Welding**—"Building Your Career in Arc Welding" is a 12-pg. booklet describing the 5 day course offered by Lincoln to provide a sound foundation for new-comers in the fields of welding design and application. Course covers joint design, weldable materials, methods and tools other basic topics. Lincoln Electric Co.

66 **Electric Welding Handbook**—A 16-pg. two-color booklet "Edco Electrodes" describes the physical and chemical properties of these phosphor bronze electric welding rods. It gives uses and techniques for welding copper, bronze, cast iron, steel and their alloys; and contains a polarity table and directions for best welding results. This handbook information will prove valuable to every welder and shop man. Welding Div., Eccles & Davies Machinery Co., Inc.

MISCELLANEOUS

67 **Highlights of Power Plant Progress**—Handsomely printed 64-pg. book, commemorates 75 years' service of Woodward Governor Co.; shows illustrations of early power plants and workshops; describes Woodward governors for waterwheels, Diesel engines and other prime movers.

68 **Continuous Oil Filtering** — "Quick Facts" is a free booklet discussing Cuno Filters for the continuous cleaning of fuel and lube oil. Requires no more space than ordinary partial-flow type. Cuno Engineering Corp.

69 **"Packaged" Air Conditioning**—Handy file folder contains descriptions and specifications for 3 hp and 5 hp Chrysler-Airtemp "packaged" air conditioners. Isometric drawings show architects and engineers how easily these conditioners can be installed in virtually every type of new and remodeling building. Airtemp Div., Chrysler Corp.

70 **Condensers and Coolers That End Water Supply Problems** — First portion of new Bulletin 1230 describes the Fin-Fan exchanger, a "package-type" unit, jointly developed by The Griscom-Russell Co. and The Fluor Corporation, Ltd. More than twenty advantages of this exchanger for condensing and cooling fluids without the use of water are concisely outlined, and typical applications are listed to show the wide adaptability of the unit. Griscom-Russell Co.

71 **Data on Barometric Condensers**—Bulletin No. 4509, "Parallel Flow Barometric Condensers" describes the use of Parallel Flow type barometric condensers as intercondensers and aftercondensers in connection with steam jet ejectors. Engineering data covers duty, temperature rise, terminal difference, condensing water requirements and a table for selecting the correct size unit. Ross Heater & Mfg. Co.

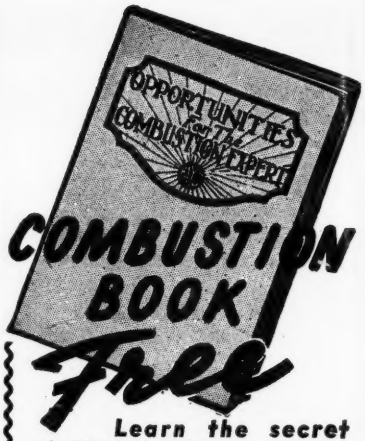
72 **Tank Construction Handbook**—New Downington Catalog No. 102 illustrates some tanks, turbine scroll cases, heat exchangers and other fabrications by Downington. Also contains facts about ASME code for unfired pressure vessels, capacity table and other handbook information. Downington Iron Works.

73 **Oil and Heat Resistant Rubber**—A new edition of its catalog section on the properties of Ameripol D, an oil and heat resistant synthetic rubber which it developed for specialized applications, has just been published by The B. F. Goodrich Co.

74 **Chemicals for Water Analyses**—New 44-pg. booklet presents various apparatus and chemicals used for Industrial Water Analyses for plant control. Features test sets required for such determinations as hardness, alkalinity phosphate, sulfate, dissolved oxygen, pH value, silica, and others. W. H. and L. D. Betz.

75 **"Industrial Logistics"**—Methods for handling materials and manufactured products economically and safely are outlined in "Industrial Logistics," a 12-pg. illustrated booklet issued by The Elwell-Parker Electric Co. It explains how a planned system of materials transportation reduces costs in procurement, production and distribution of goods.

76 **Combustioning Engineering**—Booklet "Opportunities for the Combustion Expert" gives outline of practical home study course in fuel and combustion engineering. Hays Institute of Combustion.



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WANTED—Sales manager experienced in process equipment for liquids and water treating equipment. Location middle west. Write giving age, education, experience, positions held, companies employed by, references. Salary expected. Enclose picture. Box 1502, Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

WANTED—DISTRICT SALES MANAGER water treating and process equipment for liquids. Must be familiar with these lines and have held similar positions. Location New York City. Write stating experience, education, age, companies worked for, references, positions held, salary expected, etc. Enclose picture. Box 1499. Power Plant Engineering, 53 W. Jackson Blvd., Chicago 4, Illinois.

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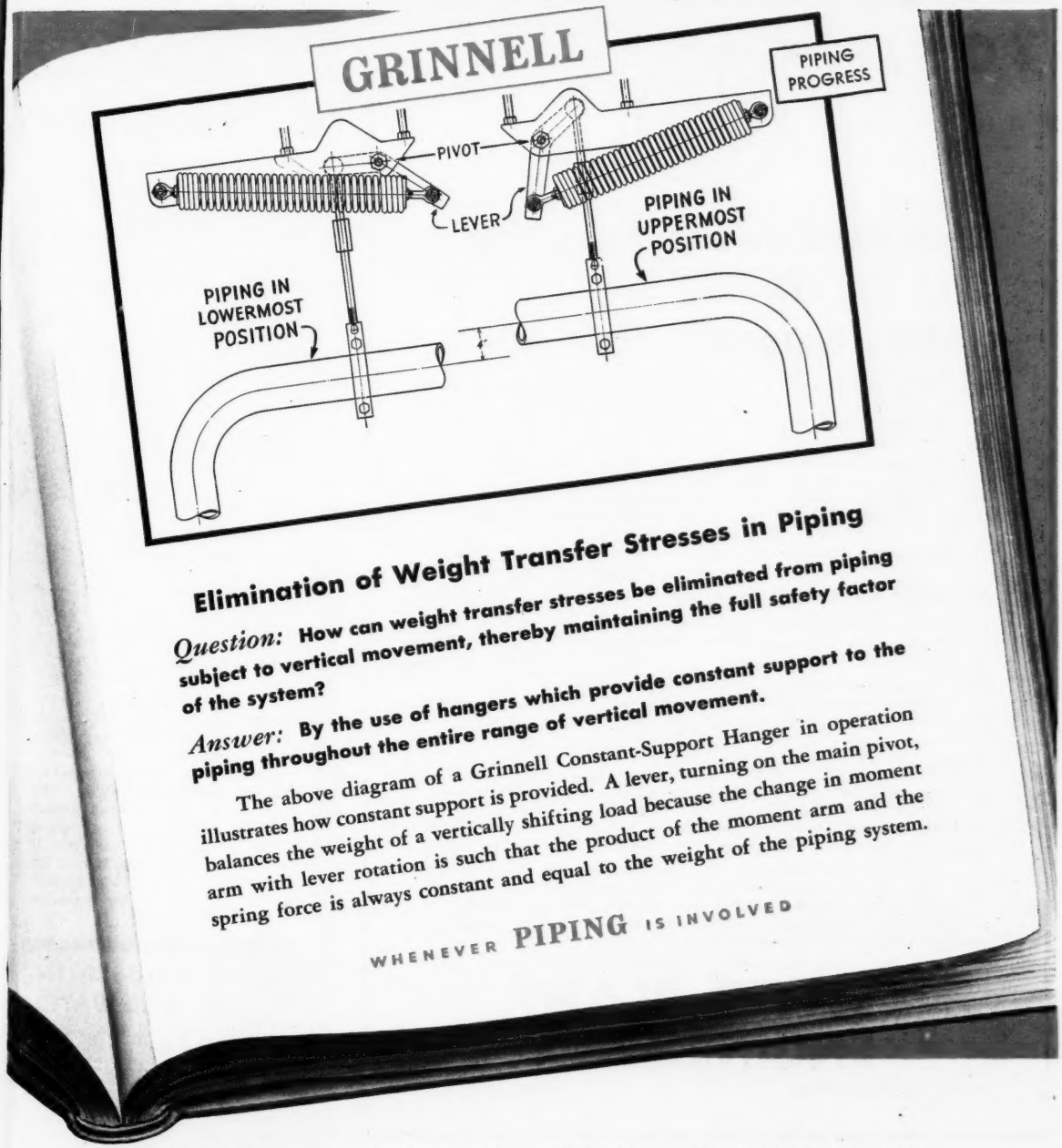
MACHINERY WANTED—Steam Turbo generating unit 3000 to 5000 kw. Address Box 1504, Power Plant Engineering, 53 West Jackson Blvd., Chicago 4, Illinois.



Elimination of Weight Transfer Stresses in Piping

Question: **How can weight transfer stresses be eliminated from piping subject to vertical movement, thereby maintaining the full safety factor of the system?**

Answer: **By the use of hangers which provide constant support to the piping throughout the entire range of vertical movement.**

The above diagram of a Grinnell Constant-Support Hanger in operation illustrates how constant support is provided. A lever, turning on the main pivot, balances the weight of a vertically shifting load because the change in moment arm with lever rotation is such that the product of the moment arm and the spring force is always constant and equal to the weight of the piping system.

WHENEVER **PIPING** IS INVOLVED

The designing and production of pipe hangers to meet the varied requirements caused by expansion, contraction, pressure, vibration and load call for a thorough working knowledge of springs, levers and other mechanical devices as well as of pipe and piping systems. As a result of 95 years of piping experience and continuous laboratory research and experimentation, Grinnell is able to offer standard and special-purpose hangers to meet every conceivable requirement in piping.

Whenever piping is involved – Grinnell has the specialized engineering knowledge to handle the job – from first plan to actual operation. Grinnell can supply everything from a tiny tube fitting to a complete power plant installation.

GRINNELL COMPANY, INC. Executive Offices, Providence 1, R. I. Branch warehouses in principal cities. Manufacturing Plants: Providence, R. I.; Cranston, R. I.; Atlanta, Ga.; Warren, Ohio; Columbia, Pa.

GRINNELL

WHENEVER PIPING IS INVOLVED

How Readers and Advertisers Benefit by ABP—Suggested Field Calls

Power Plant Engineering is proud of the fact that it is a charter member of The Associated Business Papers—a national group of business publications devoted to increasing their usefulness to subscribers and helping advertisers get a bigger return on their investment.

One particularly interesting result from our affiliation has been an ABP-suggested program of on-the-job chats with readers to find out about their workaday problems on plant operation and maintenance—how our editors and advertisers can help. ABP not only helped us work out the principles of this operation, but provided their own trained field interviewers on a lendlease basis to get us started.

319 Visits Made in 28 Industries

To date we have reports covering 319 personal visits on power engineer and executive readers in 28 different classes of industries and service establishments in 29 states.

These face-to-face interviews not only help us keep editorial material "on the beam," but also uncover many plant equipment situations which advertisers can help correct.

Plants of All Sizes Called on

To assure an accurate reader sample, we not only called on vice-presidents in charge of 100,000 hp central stations in Pennsylvania but also chewed the fat with owners and engineers of 100 hp laundries in Mississippi. Many of the interviews were made at readers' homes—after hours.

This continuing field call material, passed along through frequent Power Plant Engineering bulletins, has proved useful to many advertisers in making their messages more specific, informative and resultful. It eliminates guess-work from copy and sales planning; shows what power equipment buyers want to know.

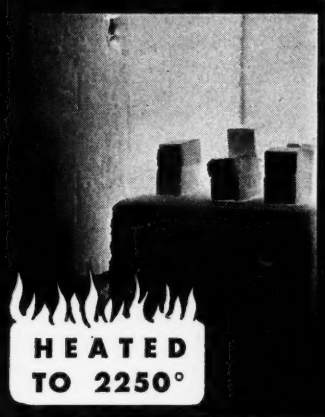
POWER PLANT ENGINEERING

53 W. JACKSON BLVD. CHICAGO, ILL.

Demonstrating

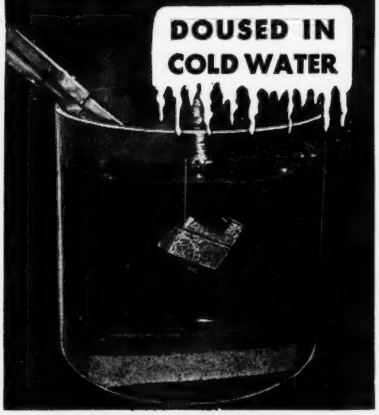
BRICKSEAL

REFRACTORY COATING



Brickseal provides a crackproof, vitrified armor for furnace linings. The small firebricks shown in the furnace were bonded and painted with Brickseal and heated to 2250°. Directly from the furnace they were plunged into cold water as shown below—a test for *any* material subject to expansion and contraction.

Brickseal is *semi-plastic when hot,* yet *hard and tough when cold.* Brickseal is made in grades suitable to heats ranging from 1400° to more than 3000°. It will make any furnace last longer by giving new life to your refractories. Write or call local dealer for a demonstration.



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BADENHAUSEN BOILERS • SUPERHEATERS

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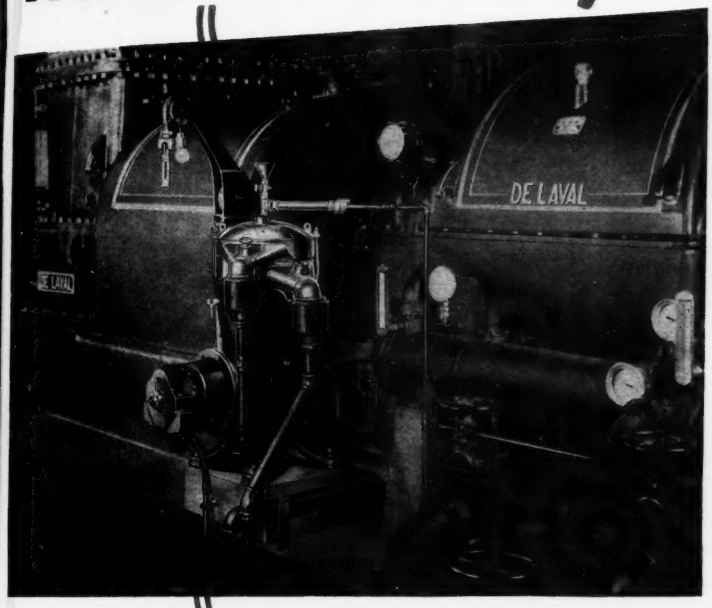
How to increase the steaming capacity of existing boilers is one problem that John Phillips Badenhausen engineers have often solved.

Further information gladly submitted on request

18TH FLOOR, PACKARD BUILDING, PHILADELPHIA 2, PA.

WHEN IS A TURBINE *Fully* PROTECTED?



...WHEN THE TURBINE OIL IS FREE FROM *DIRT* AND *WATER*

TURBINES require protection from two different causes of lubrication failure—***dirt*** and ***water***. Removal of dirt alone merely does half a job. That is why De Laval Oil Purifiers are so much more effective for maintaining turbine oil than any other means available. They instantaneously remove solid foreign matter and any moisture that may be present as well.

It is extremely important to get this ***double*** protection, for water is the real trouble-maker as often as not. For example, condensate in oil leads directly to the formation of sludge, and of course there is always the possibility of a major water leak which might lead to serious emulsification and very real trouble.

De Laval centrifugals have another advantage—they do not remove oil-soluble additives. Action within the Purifier is wholly mechanical and the oil is discharged with such additives intact.

In short, De Laval Oil Purifiers maintain oil in condition most nearly identical with that of new oil.

• Write for Bulletin No. 400.

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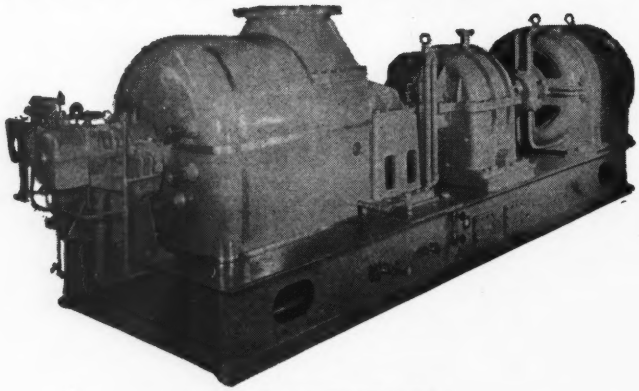
DE LAVAL OIL PURIFIERS

FOR MORE DEPENDABLE POWER PRODUCTION

MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycle alternating current on steam at 285# gauge, 700 degrees F., and exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

MURRAY *also produces:*

Mechanical drive turbines, horizontal and vertical
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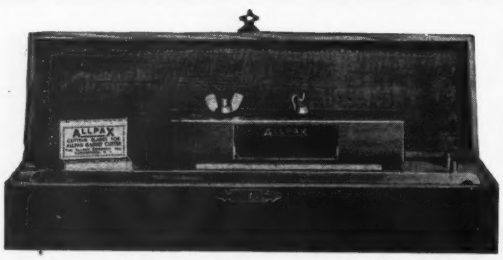
BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY



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The most remarkable tool ever invented.

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PORTABLE INDUSTRIAL VACUUM CLEANER
reduces
DUST DANGER

QUICKLY cleans walls, floors, line shafting, pipes, overhead beams, etc. Reduces health and fire hazards. Improves working conditions and morale. Cuts waste. Salvages valuable scrap. Increases efficiency.

A real one-man unit. Weighs only 40 lbs. 1 H.P. universal motor, 49" waterlift, 175 c.f.m. Removes dust, chips, lint, etc. Does a thorough cleaning job. Attachments for cleaning everything.

Convertible into Blower for blowing dust and dirt out of motors, generators and hard-to-reach places. Adaptable for spraying paint and insecticide.

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TAKE THE DUST OUT OF DUSTRY
TORNADO

LaMotte Testing Equipment to Control Corrosion in Your Plant

La Motte Block Comparator for pH Control

The LaMotte Research Department has developed LaMotte pH, chlorine, and other corrosion control testing equipment to assist in solving this problem. Write for copy of our Special Corrosion Control Report.

If you do not have the "ABC of pH Control," a complimentary copy will be sent upon request without obligation.

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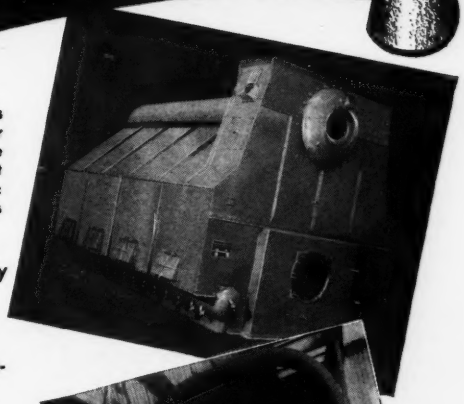
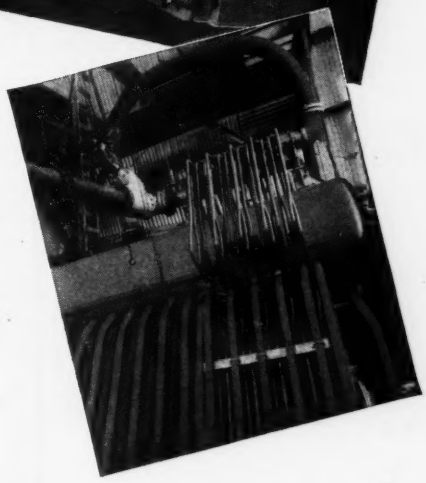
ENGINEERS THE COUNTRY OVER APPRECIATE THE EXTRA DESIGN IN WICKES CROWN





Above: Side and end sketches of Wickes Crown A-Type Boiler installed in a large automobile factory. Right: A package unit ready for shipment. Below: Wickes Crown A-Type Boilers during erection.

Because they are simply and compactly designed to conserve head room and floor space, yet incorporate all the outstanding features of modern steam boiler design, Wickes Crown A-Type Boilers enjoy wide popularity throughout industry. Each side furnace wall is a separate steam generator, yet an integral part of the boiler unit. The upper drum, as well as the two lower drums, are fully protected from the intense heat of the furnace. Waterwalls are used to protect the front and the rear refractory walls, yet no complicated headers or circulating tubes are used. The entire boiler is steel-cased. Our engineers will be glad to study your boiler needs and determine how Wickes Crown A-Type or other Wickes boilers can increase power efficiency in your plant.

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Type "D" is so popular with engineers because it is:

Simple. Its simplified design insures notably accurate and close regulation of pressures.

Easy to Inspect. Equipped with single seat renewable discs of composition or metal; stainless steel valve stem; and removable diaphragm top.

Adaptable. For pressures up to 175 psi—Steam, Air, or Gas.

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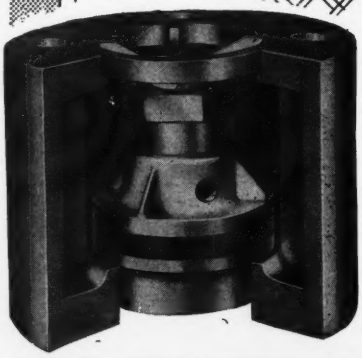
JOIN THE *"Anti-Noise"* CAMPAIGN...

Use COMBINATION **SILENT** CHECK VALVES

ENDS "Water Hammer" on Boiler Feed Lines, Foot Valves, House Pumps, Liquid and Steam Lines.



Your first step in assuring smoother, quieter, more efficient pump discharge, is the installation of Combination SILENT CHECK VALVES.

Note these important money-saving features: 1. Spring-Loaded—when flow ceases, valve is closed without chance of water hammer; 2. Area through valve is 20% in excess of pipe area; 3. Really silent in operation; 4. All valve wear is on easily replaced or repaired parts; 5. Works equally well on Boiler Feed Lines, House Pumps, Liquid and Steam Lines; also used as Foot Valves.

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Designate NICHOLSON TRAPS

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DEAD-SURE

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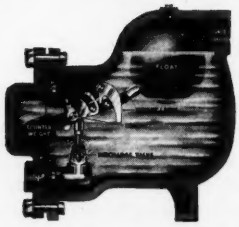

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Fast action, enormous drainage capacity, and ruggedness enabled Nicholson traps to make striking wartime records. Continuing plant tests show that you can depend solidly on Nicholson traps to: (1) Promote production efficiency; (2) Furnish trouble-free long wear. Nicholson makes weight-operated, piston-operated traps; thermostatic steam traps; air, gas, gasoline traps. Pressures to 1500 lbs. For dependable, ready aid on drainage problems, consult Nicholson.

For Details Send for Catalog 444

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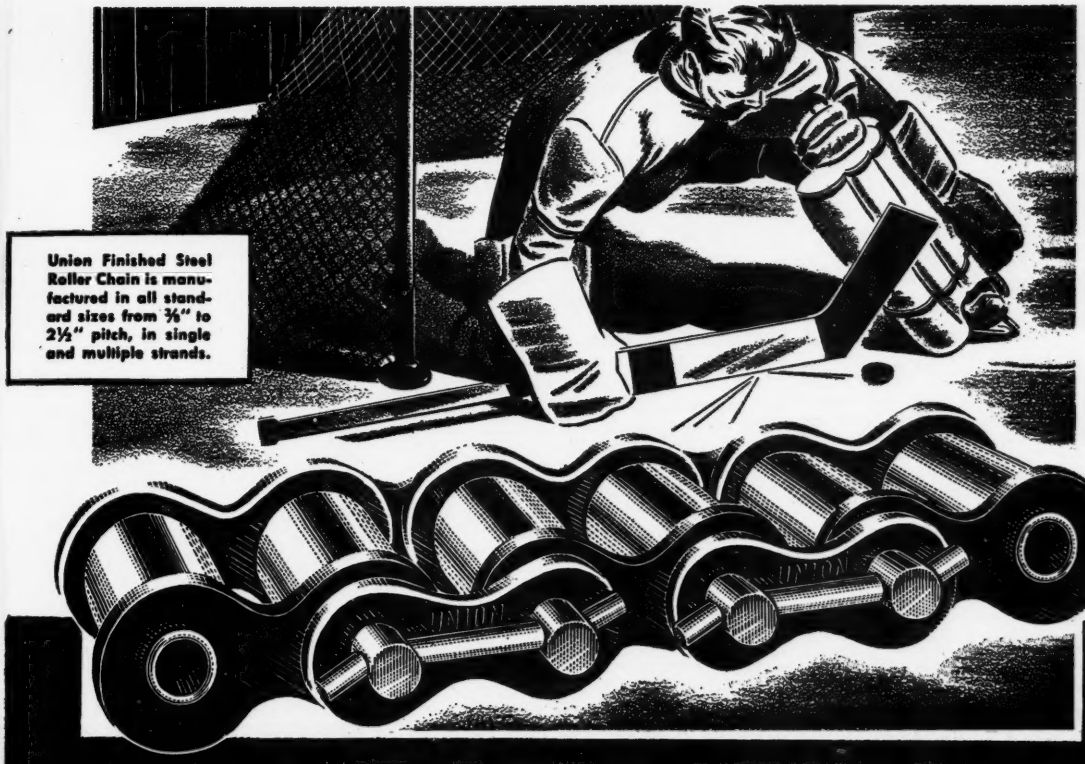

Union Finished Steel Roller Chain is manufactured in all standard sizes from ⅜" to 2½" pitch, in single and multiple strands.

Specializing In Punishment Capacity

☆ The work of a goalie calls for the stamina and dependability which only ruggedness can provide.

Since we confine ourselves to the manufacture of a complete line of steel chains, sprockets and flexible couplings, our specialized efforts are constantly directed toward increasing the stamina and dependability of our products. Specifications for the steel used in each part are carefully selected and since we manufacture a complete line of chains, we necessarily have the most efficient tools for each machining operation. Finally, we consult with our customers in order that we may recommend the correct chain for each application and later instruct them in proper lubrication. These are the reasons why Union Chains frequently demonstrate an exceptional ability to withstand punishing usage.

The Union Chain and Manufacturing Company, Sandusky, Ohio, U. S. A.

Union Chains for Every Application

Drive and Conveying Chains and Sprockets
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- Combination Malleable Iron and Steel Chain
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Finished Steel Roller Chains and Sprockets
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Silent Chain and Sprockets
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Flexible Couplings
- Roller chain type
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Catalog A-2 covers Drive and Conveying Chain. B-2 covers Finished Steel Roller Chain. FC-1 covers Flexible Couplings. Ask for your copies.

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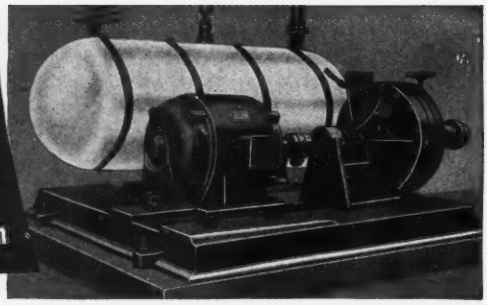
UNION CHAINS

Increase
YOUR PRODUCTION
with the
STOUT NO-VENT
Boiler Return System



—for Cookers, Heaters, Driers, etc.

It operates continuously returning condensate, ALL OF IT, fast as formed and at the same pressure and temperature at which it leaves the steam heated units. Air and non-condensibles are then automatically removed and the condensate, in the form of distilled water, returned direct to boiler. There are no traps or orifices in the system.

High temperature direct return saves fuel. Often 25% or more. (This would offset the 20% cut expected in soft coal deliveries to industry as announced July 14th by Secretary Ickes.)

Improved circulation the Stout NO-VENT way uniformly increases the temperature in steam heated units and increases production. Reducing boiler load and returning distilled water prolongs boiler life.

If you operate steam heated cookers, heaters, driers, ironers, clothing presses, drying ovens, oil tanks, water tanks, pickling tanks or have other uses for so-called "process steam" investigate the Stout NO-VENT Boiler Return System. It can boost your production.

DAVID STOUT & SONS • 6 N. Michigan Ave. • CHICAGO 2, ILL.
Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

Write for bulletin showing hookup of Stout NO-VENT System and giving operating details. Made in capacities 100 to 800 bhp, pressures to 200 lb. Distributors will be interested in selling franchise.

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**CHIMNEYS . . .
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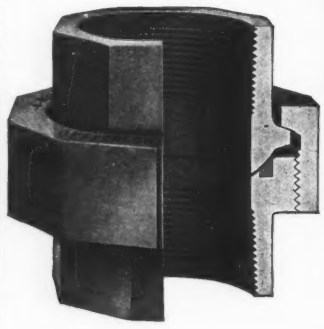

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It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

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Factories at Lexington 73, Mass., and Lockport, N. Y.

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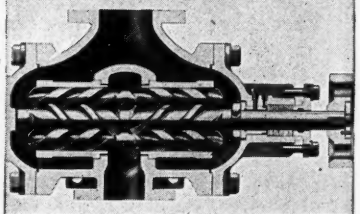

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at all capacities and pressures
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We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.
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You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

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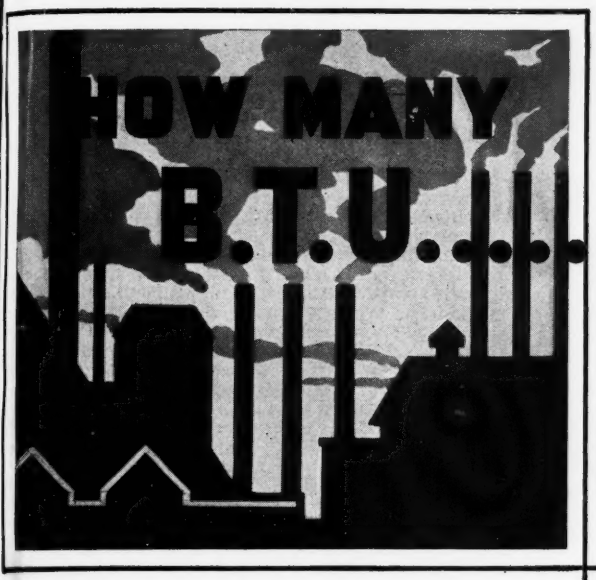

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In any operation where Diesel power is used, an important amount of usable heat goes out the exhaust pipe and is totally wasted. This heat, transformed into steam or hot water, could in most cases be used to good advantage . . . without a cent of added fuel cost.

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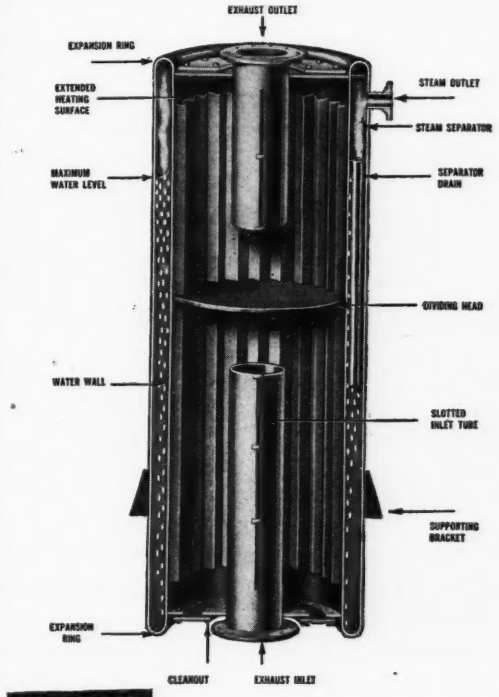

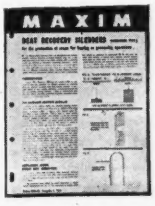

Heat Recovery Silencer Bulletins WH-100, WH-102 and WH-103 will be sent promptly on request.

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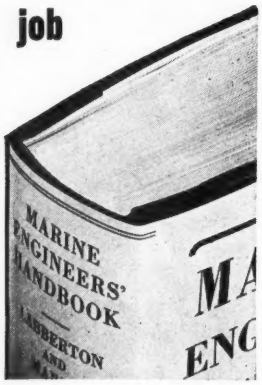

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POWER PLANT *Construction News*

Ala., Birmingham—Alabama Power Co., Birmingham, has authorized appropriation of about $8,000,000 for extensions and improvements in power plants and properties during present year, including increase in station capacity, power substations, transmission and distributing lines, and other facilities. Work scheduled to begin soon.

Ark., Little Rock—American Can Co., 230 Park Ave., New York, N. Y., plans installation of electric power equipment in new branch tin can-manufacturing plant at Little Rock, where site has been selected. It will comprise a main one-story production unit and several auxiliary structures. Boiler and power substation are planned. Entire development will cost about $1,000,000. Proposed to begin work soon.

Calif., Los Angeles—Red-EE-Foods, Inc., 1548 South Central Ave., prepared food products, plans installation of electric power equipment in new three-story and basement factory at 4340 Colorado Blvd., reported to cost close to $160,000, with machinery. Jack H. MacDonald, 1013 East 8th St., Los Angeles, is architect.

Calif., Los Angeles—Sunny Sally Vegetable Growers, Inc., 4214 South Produce Plaza, Vernon district, plans installation of electric power equipment in new one-story food-processing plant at Leonas and Seville Sts., about 20,000 sq ft floor space. Cost reported about $100,000. Douglas McLellan, Architects' Building, Los Angeles, is architect.

Fla., Miami—Florida Power & Light Co., Miami, plans expansion and improvement program during 1946-47 to cost close to $24,000,000. Project will include extensions in Lake Monroe generating station near Sanford, to triple present capacity. Also new plant, about 40,000 kw rating to be constructed in lower East Coast district, on site to be selected soon; transmission and distributing line extensions, power substations and other operating facilities.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., has taken out permits for two multi-story additions to calumet generating plant, East 100th St., 141 x 200 ft, and 143 x 165 ft, for expansion in steam and electric divisions. Structures are estimated to cost close to $2,000,000. Installation will include a new 107,000 kw hydrogen-cooled turbine-generator unit, high-pressure boilers and accessories, with entire project to represent an investment of about $10,000,000. Completion is scheduled in 1947. Sargent & Lundy, 140 South Dearborn St., Chicago, are consulting engineers.

Ill., Hinsdale—Municipal Utilities Department, Park Ave., has plans in progress for extensions and improvements in municipal steam-electric power plant, with installation of equipment for increased capacity. Cost reported about $300,000. Laramore & Douglass, Inc., 327 South LaSalle St., Chicago, Ill., is consulting engineer.

Iowa, Alta—Municipal Light Department will have plans prepared soon for expansion and improvements in municipal steam-electric power station, to include new generator and auxiliaries, boiler, stoker and other miscellaneous equipment. Estimates of cost are being made.

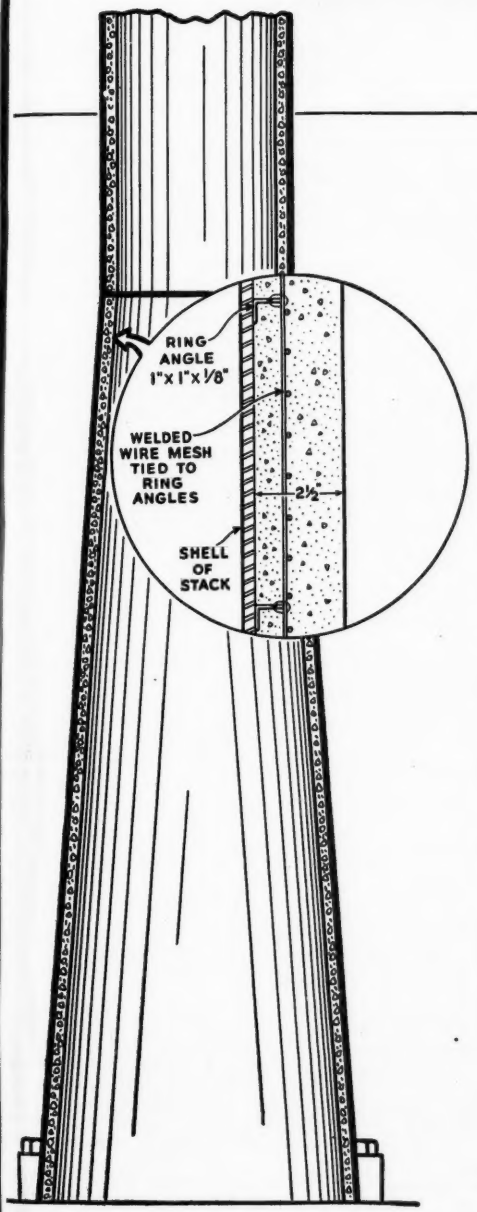
Iowa, Boone—City Council has preliminary plans under way for new water softening plant for municipal water system, estimated to cost about $150,000. George Nelson is city engineer, in charge.

Iowa, Davenport—Iowa-Illinois Gas & Electric Co., Rock Island, Ill., plans extensions and improvements in generating station at Davenport, with installation of additional equipment for increased output. A similar program will be carried out at power plant at Moline, Ill. This will be part of a development project scheduled for 1946, entire program estimated at $2,500,000, including transmission and distribution lines.

Iowa, Sibley—Town Council plans improvements in municipal power plant, with installation of new cooling tower, coal-handling equipment and other facilities. Estimates of cost being made. Proposed to ask bids soon. Ralph D. Thomas & Associates, Inc., 1200 Second Ave., South, Minneapolis, Minn., is consulting engineer.

Ky., Louisville—Louisville Gas & Electric Co., 311 West Chestnut St., has plans maturing for extensions in power plant, to include installation of new 50,000 kw turbine-

PROTECT STEEL and IMPROVE DRAFT with LUMNITE STACK LININGS



Corrosion-resistant linings insure long life for steel stacks. Insulation prevents oxidation, keeps gas temperature up and boosts the draft. LUMNITE linings are refractory, insulating and resistant to corrosion.

Stop oxidation, prevent the corrosive action of sulphurous flue gases, insulate the steel from high temperatures, and you have forestalled the enemies that destroy steel stacks. The jointless LUMNITE linings are in close contact with the steel. They allow no "breathing"; aggressive condensate cannot reach the shell of the stack.

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2. Coal Bunker Linings.
3. Flue and Duct Linings
4. Steel Stack Linings.
5. Mortar for Brick Chimneys and Linings.
6. Castable Refractories.
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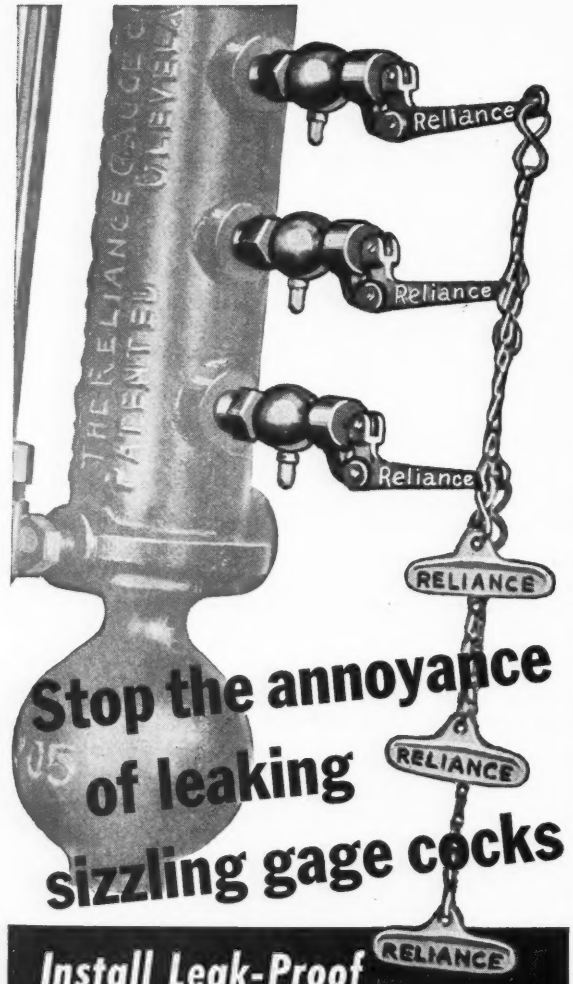

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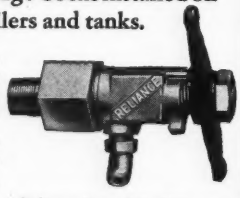

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generator, high-pressure boiler and auxiliary equipment. Work scheduled to begin at early date. Public Utility Engineering & Service Corp., 231 South LaSalle St., Chicago, Ill., is consulting engineer.

La., Plain Dealing—Village Council is considering plans for new municipal power plant and electrical distribution system, using Diesel engine-generator units. Cost estimated about $104,800. Proposed to arrange financing soon.

Md., Baltimore—Bethlehem-Sparrows Point Shipyard, Inc., Sparrows Point, plans installation of electric power equipment, including substation facilities, in connection with reconversion of plant for peacetime operations. Work will be carried out at once and is reported to cost close to $650,000. Company is an interest of Bethlehem Steel Co., Bethlehem, Pa.

Mich., Newberry—Water and Light Board, City Hall, has plans under way for extensions and improvements in municipal power plant, with installation of new Diesel engine-generating unit, about 500 kw capacity and auxiliary equipment. Cost about $83,600. Financing in part has been arranged through Federal aid.

Minn., Lake Benton—Lake Benton Service Club is sponsoring a project for construction and operation of a municipal power plant and electrical distribution system. Estimates of cost are being made and a municipal bond issue will be arranged for required amount. It is understood that Diesel engine-generating units will be used.

Neb., Lincoln—Water and Light Department, City Hall, plans extensions and improvements in steam department at municipal power plant, A and 30th Sts., with installation of new boiler and auxiliary equipment. Cost estimated about $200,000. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Neb., Wisner—Electric Light and Water Department is considering improvements in municipal power station, including new cooling tower and other facilities, switchboard extensions, etc. Estimates of cost are being made.

N. J., Rahway—State Department of Institutions and Agencies, State House, Trenton, N. J., has plans under way for extensions and improvements in power plant at State Reformatory, Rahway, estimated to cost about $135,000, with equipment. Also will make similar additions to power station at Totowa, to cost approximately $140,000, with equipment. State Engineering Department, address noted, will prepare plans.

N. Y., Syracuse—Construction Service, Veterans' Administration, Washington, D. C., plans power plant at proposed new neuropsychiatric hospital at Syracuse, where site is being selected. Also refrigerating plant, air-conditioning system, outdoor electric distribution lines and other power facilities. Project will comprise a large group of one and multi-story buildings and is estimated to cost about $7,426,000. Appropriation is being arranged.

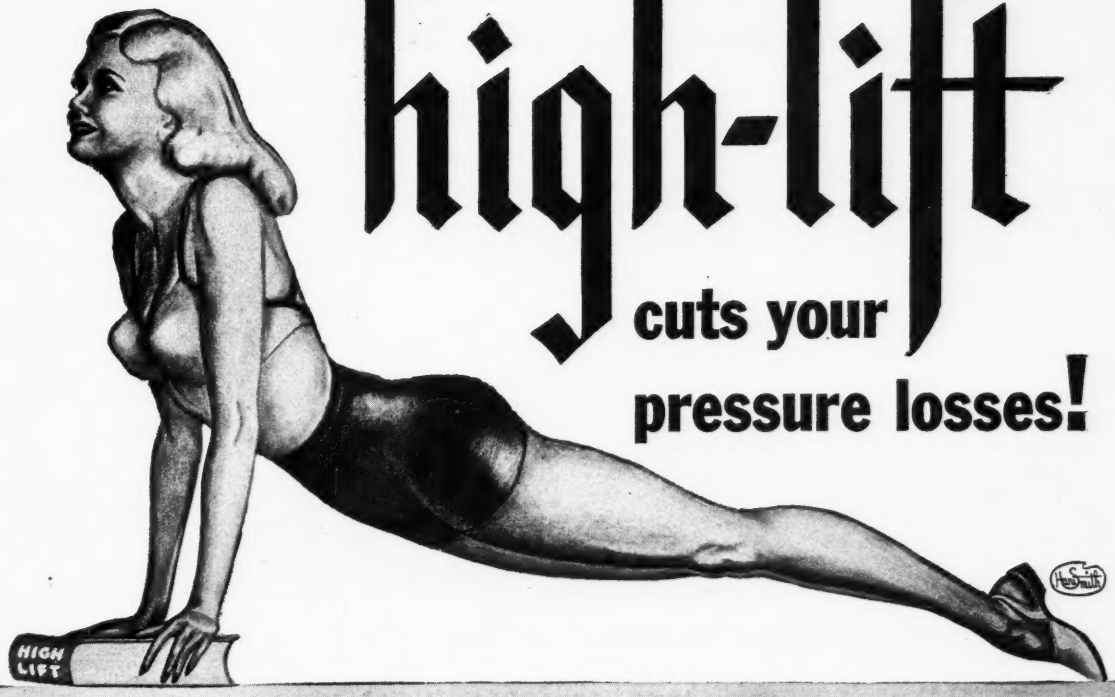
Ohio, Cleveland—Cleveland Electric Illuminating Co., Illuminating Building, is arranging an expansion and improvement program in plants and system to cost about $9,000,000, to be carried out during next 12 months. Program will include power station betterments, large power substation for 132,000 v transmission system, number of new distribution substations, transmission and distribution lines.

Ore., Albany—Albany Ice & Cold Storage Co., 627 West Third St., plans new one-story cold storage and refrigerating plant, about 120 x 180 ft, estimated to cost close to $150,000, with equipment. Site has been acquired in South Albany. Proposed to carry out work early in spring. Annand & Kennedy, Central Building, Albany, are architects and engineers.

Pa., Philadelphia—Construction Service, Veterans' Administration, Washington, D. C., plans new general medical hospital at Philadelphia, comprising large group of one and multi-story institutional buildings, with power plant, refrigerating plant, air-conditioning system, mechanical laundry, outdoor electrical distribution lines, power substation and other facilities. Cost estimated about $10,900,000. Appropriation is now before Congress for approval.

Texas, Houston—Construction Service, Veterans' Administration, Washington, D. C., has plans under way for new neuropsychiatric hospital at Houston, consisting of a large series of one and multi-story institutional buildings, with power plant, refrigerating plant, mechanical laundry, air-conditioning system, outdoor overhead and underground electrical distribution system, elevators and other electrical facilities. Cost estimated about $7,315,000. Appropriation is now before Congress for approval.

high-lift cuts your pressure losses!



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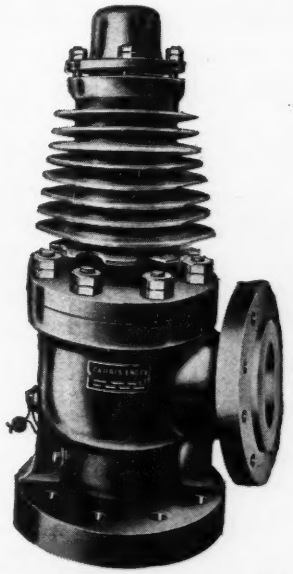

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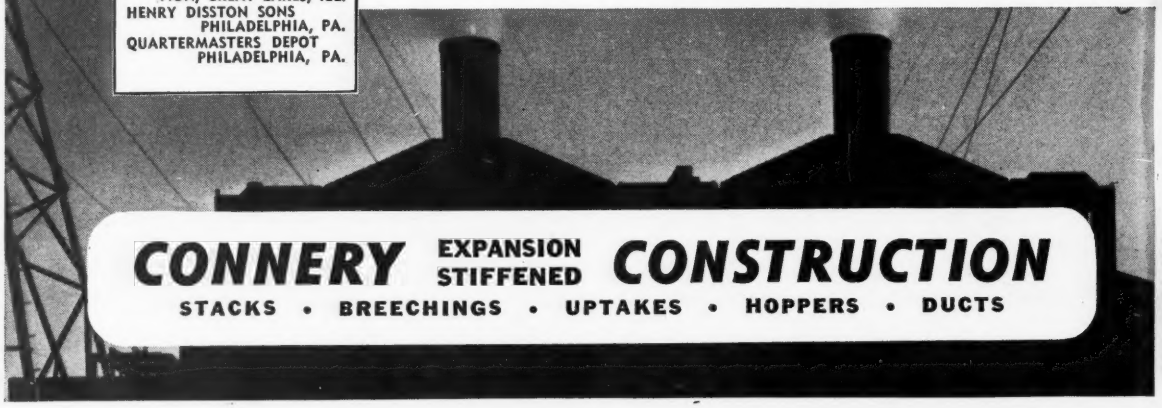

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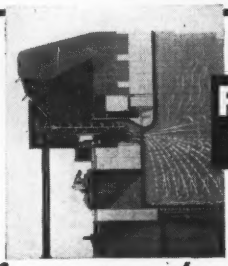

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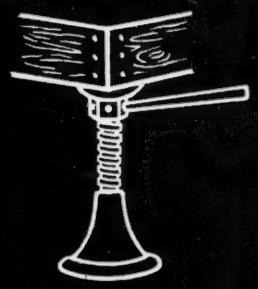

...the Jack Screw

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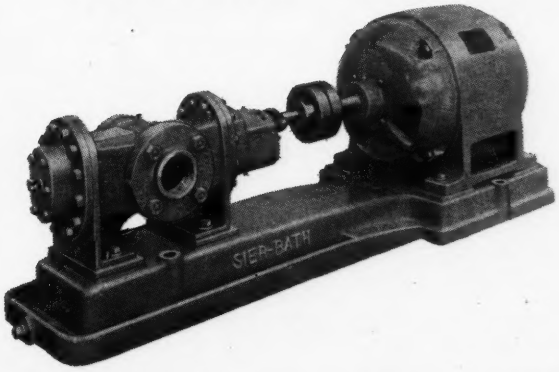

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For Pumping Asphalt, Acetate, Brines, Bunker C Fuel Oil, Cellulosics, Greases, Molasses, Syrups

Sier-Bath Screw Pumps

Lifting houses, propelling ships, the big jobs are done by screws. In pumping thick fluids, the screw's tremendous torque is applied by Sier-Bath Screw Pumps. Handling fluids of higher viscosity than conventional displacement pumps, they start more quickly on cold days and reduce fluid heating costs. In oil burner service, their pulseless discharge prevents "puffy" firing and reduces tip cleaning. Thus, it improves boiler efficiency. Where automatic operation is used, they do not cause "hunting" or overcontrolling.

Smooth and quiet in operation, Sier-Bath Screw Pumps are high in efficiency, low in maintenance and less affected by head. Even when slanted, they maintain constant flow. Sier-Bath Screw Pumps require no heavy foundations—an advantage in marine or temporary installations. Sier-Bath Screw Pumps are built to close tolerances. Removable liners may be specified. *Every Sier-Bath Screw Pump incorporates needle bearings because Sier-Bath pioneered in the use of needle bearings as standard equipment in screw pumps.* Write for bulletin.

Made by the manufacturers of Sier-Bath Precision Gears.

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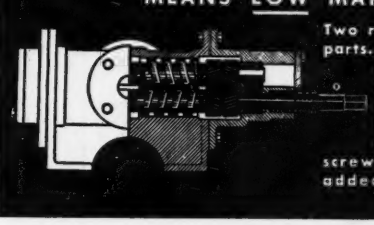
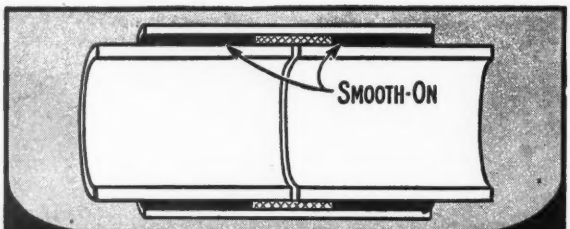
Only Two Moving Parts

MEANS LOW MAINTENANCE



Two rotors are the only moving parts. End to center fluid movement eliminates thrust bearings in horizontally mounted units. Self-centering timing gears prevent sidewear resulting from screw contact. Packing can be added while pump is running.



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AVERTED STEAM STOPPAGE *in very cold weather*

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Patterson-Kelley is an *engineering* as well as a manufacturing organization, designing heat transfer units of many types to customers' requirements. We bring to the problem of heat transfer a thorough understanding of its underlying principles.

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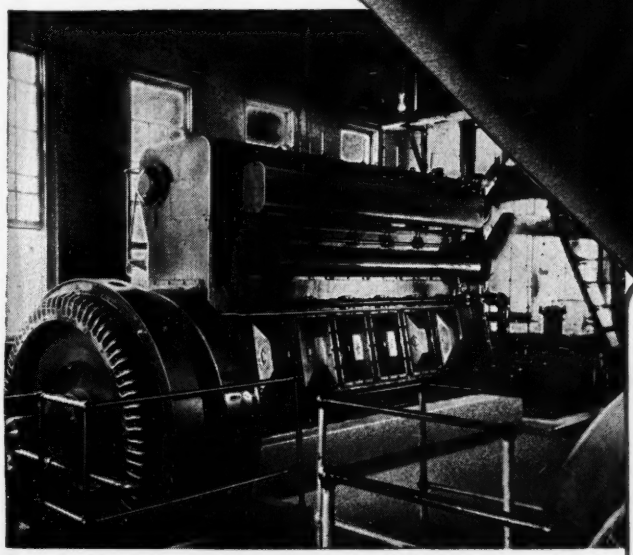

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Coils, Bends, Assemblies, for ice and refrigerating plants, cold storage houses, chemical works, blast furnaces, soap factories, feed water heaters, car heaters, all purposes for which bent pipe is used.

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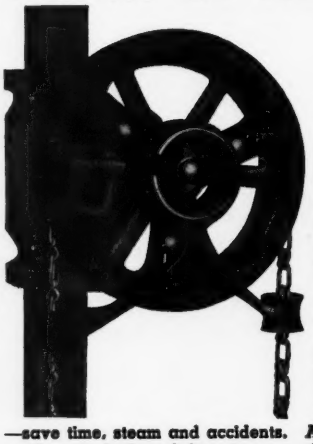

with Babbitt Sprocket Rims on all your "high-up" valves. No need of keeping a long, cumbersome ladder always on hand just to close a valve.

Babbitt Rims give you instant and positive control of overhead valves from the floor —save time, steam and accidents. Adjustable to any valve, easily attached and low in cost. Don't delay. Get your Babbitt Rims now! Complete information on request.

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Please send me complete FLEXTITE information . . . . details of FREE TRIAL OFFER—no obligation.

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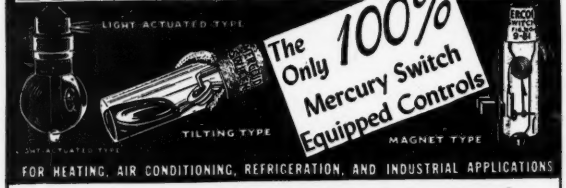

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Pressure Control—*For various industrial applications. The operating range is plainly indicated on a visible dial. Adjustments are easily made.*

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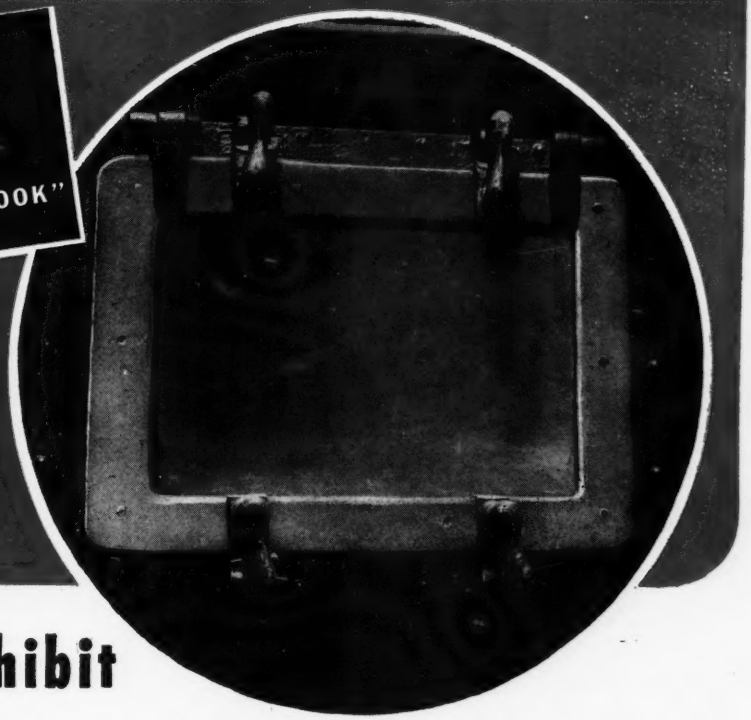
PAGE 3

OAKITE

"PRESCRIPTION NOTE BOOK"

ONE OF A SERIES of data sheets for power plant engineers outlining various Oakite maintenance and equipment cleaning tasks. Each sheet may be filed for reference to serve as a reminder for obtaining more specific information.



New way to inhibit SLIME and SCALE in air conditioning and humidifying equipment...

Developed by the Oakite Research Laboratory, a NEW chemical development is now available that provides a successful answer to the problem of controlling and inhibiting slime, odors and lime scale in closed systems of water-wash air conditioning equipment . . . or in humidifying equipment designed to maintain a high relative humidity in connection with processing or manufacturing operations.

This NEW material . . . Oakite Airefiner No. 52 . . . is a white, free-flowing powder, completely soluble in water and odorless in both dry and solution form. Economical, safe to use and non-toxic, its highly effective germicidal and fungistatic properties are extremely potent in controlling slime formation and growth of mold organisms. You merely add Oakite Airefiner No. 52 to water supplies in the recommended concentration. A free 3-page Special Service Report gives you further details. Write for your copy today.

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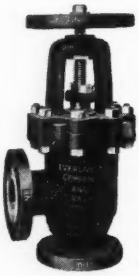
Install an Everlasting Duplex Blow-Off Unit and you will be SURE of completely dependable valve teamwork. Quick opening and closing supplied by the "regular" model W Everlasting lever-operated Valve . . . security completed by the wheel-operated Everlasting Companion Valve.

The Everlasting Valve opens with an easy 70-degree movement of the operating wrench; provides unimpeded straight-through flow; closes with the same ease and sureness. Each opening or closing action regrinds the disc, keeping it tight-fitting.

The sealing valve

The Everlasting Companion Angle Valve bears the brunt of the blow-off force and supplies necessary resistance to the wearing action of the boiler water.



The blowing valve

The Everlasting Duplex unit meets all code requirements for boiler-blow-off service. Either valve may be obtained separately.

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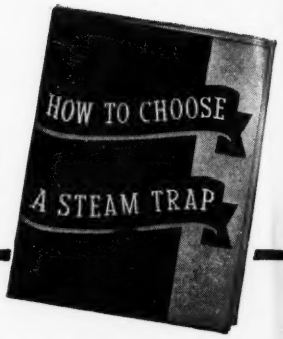
for everlasting protection

Tells how, what, where, and why



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This 40-page book gives condensation rates for the different types of steam-using equipment . . . how to select the right size trap . . . explains trap capacity factors . . . how to determine lift of a trap . . . correct trapping of unit heaters . . . trap selection where large volumes of air occur . . . trapping pipe coils in still air and for blast heating . . . Jacketed kettles, autoclaves, submerged surfaces . . . hospital, kitchen and laundry applications . . . trapping mains, drips and special equipment . . . covers trapping practices and theory, installation, operation and maintenance. Included is a description of the Super-Silvertop Steam Trap and details of simplified piping. Send for your FREE copy.

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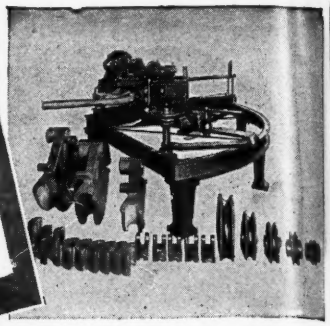

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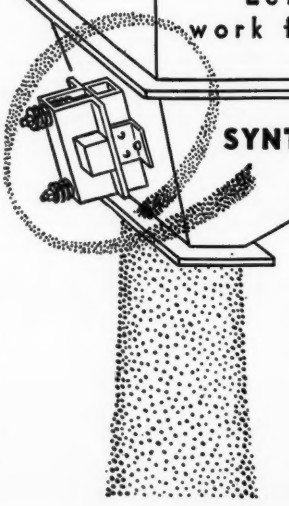

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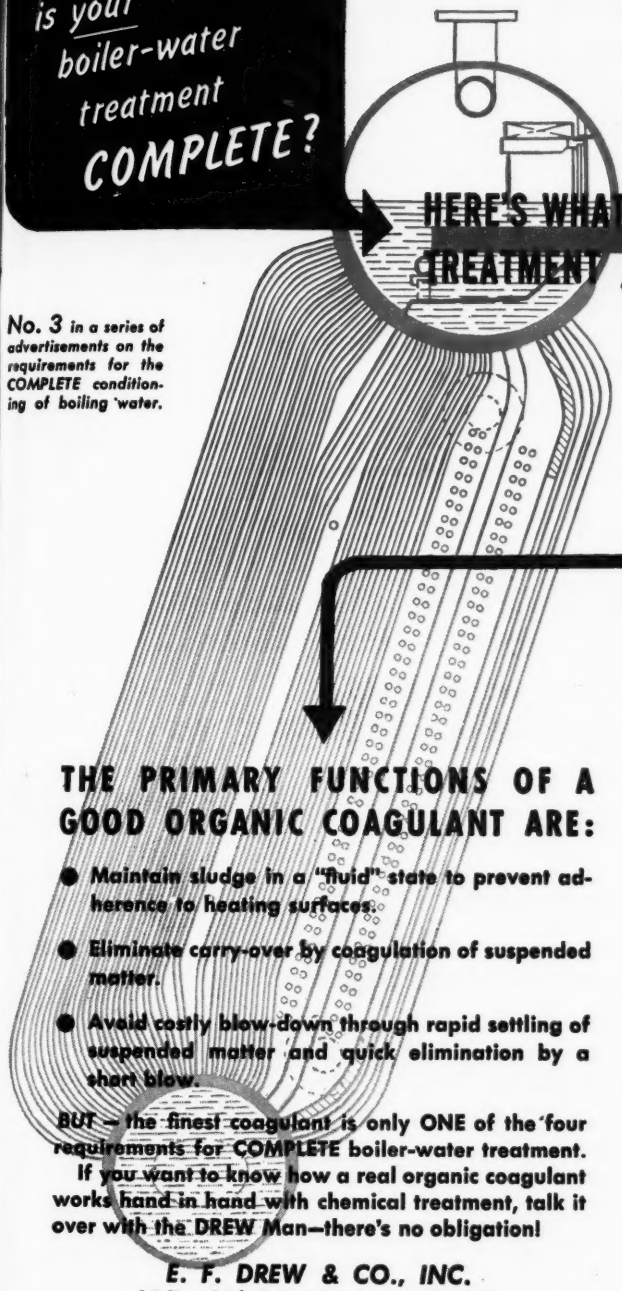
is your boiler-water treatment **COMPLETE?**



No. 3 in a series of advertisements on the requirements for the COMPLETE conditioning of boiling water.

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1. Sound Chemical Treatment
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2. A Good Organic Coagulant

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(to be discussed in the April issue)

4. Competent Service & Instruction
(to be discussed in the May issue)

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BUT — the finest coagulant is only ONE of the four requirements for COMPLETE boiler-water treatment.

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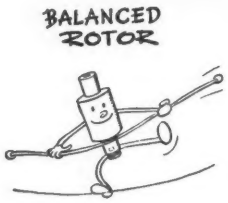

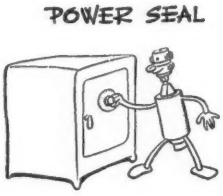

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. . . these are the features found

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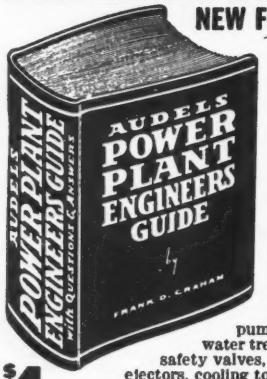
WITH QUESTIONS AND ANSWERS



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Corrosion occurs when oxygen or acid gases act on metal. Oxygen and carbonic acid gas are found dissolved in all natural waters to a varying degree. Hydrochloric acid gas is formed under steaming conditions, when chlorides of iron, magnesium, calcium or sodium are present in feedwater. The liberation of hydrochloric acid gas from these substances is accelerated by the presence of sulfates of calcium and magnesium. Carbonic acid gas is liberated from bicarbonates of calcium and magnesium.

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CHEMICALLY
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*Gamlenizing boiler metal surfaces makes them corrosion-proof, protecting against destructive action of acids in the combustion deposit, and greatly reducing the adherence of future deposit. Only Gamlenite has this feature.

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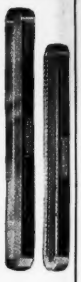

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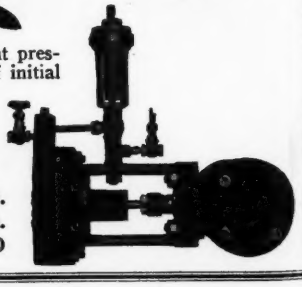

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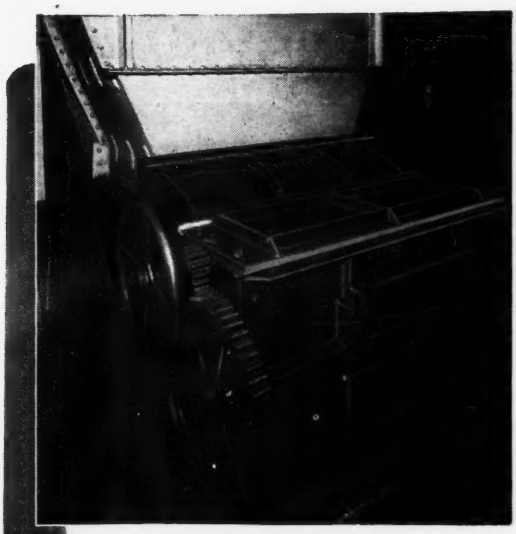

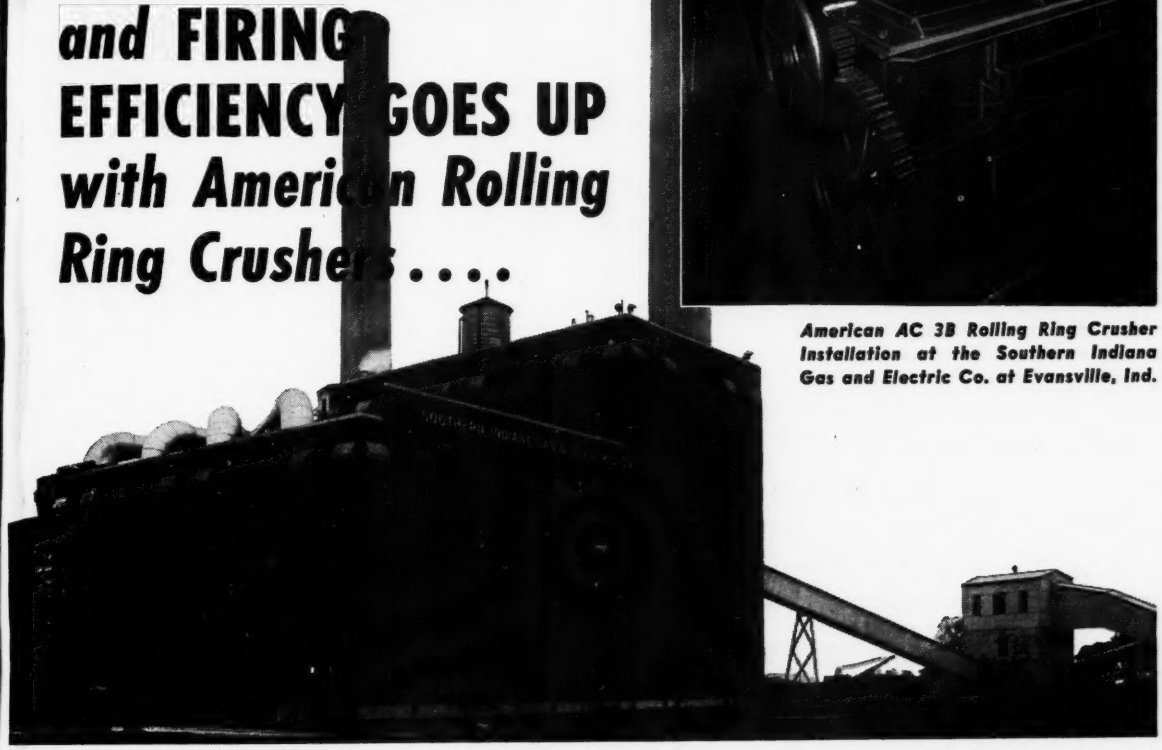

American AC 3B Rolling Ring Crusher installation at the Southern Indiana Gas and Electric Co. at Evansville, Ind.

COAL IS SPLIT -NOT CRUSHED

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On the rotor multiple manganese shredder rings, each with 20 cutting edges, split coal instead of crushing it to provide a uniform product with high tonnage at low cost. Each shredder ring revolves freely on its own shaft and deflects from tramp iron. No shear pins or conventional safety devices to bother with.

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American Rolling Ring Crushers have an average operating cost of less than 1 cent per ton—including power, depreciation, labor and all overhead costs.

Their low cost dependable operation is proved in performance all over the world.

Americans are sturdily constructed yet compact and easily installed in limited headroom. Capacities up to 500 TPH.

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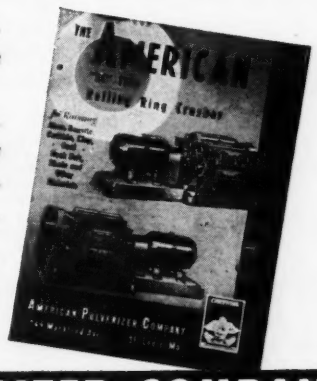

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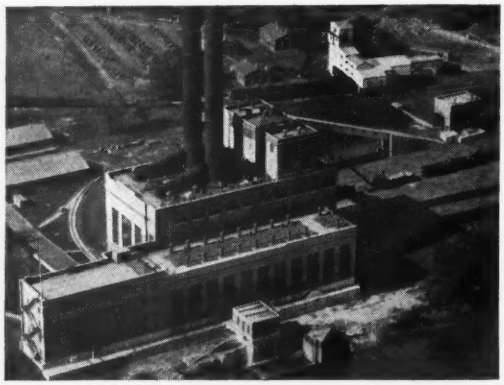

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CASE Histories: Boiler Maintenance

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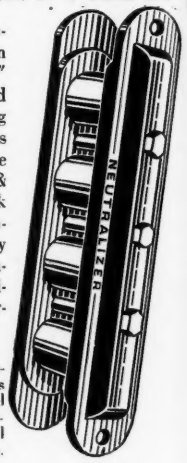
"Previous to the time we installed Electro Neutralizers our boilers were in an unusually bad condition . . . having ¼" of old hard scale and the top coated with rust. The rust is fast disappearing as well as the scale; parts of the boilers are now showing bare metal," wrote J. E. Osborne, Mgr., Swiss Cleaners & Dyers, Louisville. Sold on money back guarantee and users protected by insurance policy. Sold by leading Supply Jobbers nationwide, or write for literature and recommendations without obligation. The Electro Chemical Engineering Co., Louisville 2, Ky.



Controls pH value of water automatically Removes old scale, lengthens boiler life, increases steam efficiency, reduces repair cost. Cuts fuel consumption from 15% to 25%. Stops the eating of metal, pitting, foaming, carry-over and all types of corrosion including electrolytic action. Produces mineral-free water and pure steam, prevents new scale formation regardless of cause or type.

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FOR WATER CORRECTION AND POSITIVE BOILER-SCALE ELIMINATION

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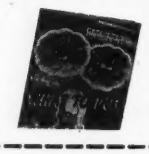

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for alkaline, sulphureus and leakage protection of tanks, stacks & breechings has been time tested by industry. One of the world's largest packing plants lined several hundred tanks with PLASTIKSTEEL during 1944. Repeat order received September, 1945.

Picture at right showing 200,000 gallon R. R. tank being lined with PLASTIK-STEEL.

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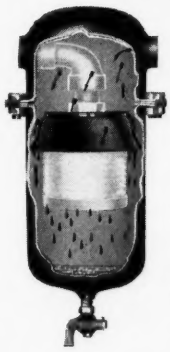

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Deflector cup directs flow of air or gas together with water, oil and dirt to the walls of the housing and thence downward at high velocity into the base where liquid and heavier dirt particles are deposited.

2. FILTRATION

Air or gas, having been mechanically cleaned, rises at low velocity through the Radial Fin Filtering element or insert which removes the lighter airborne material.

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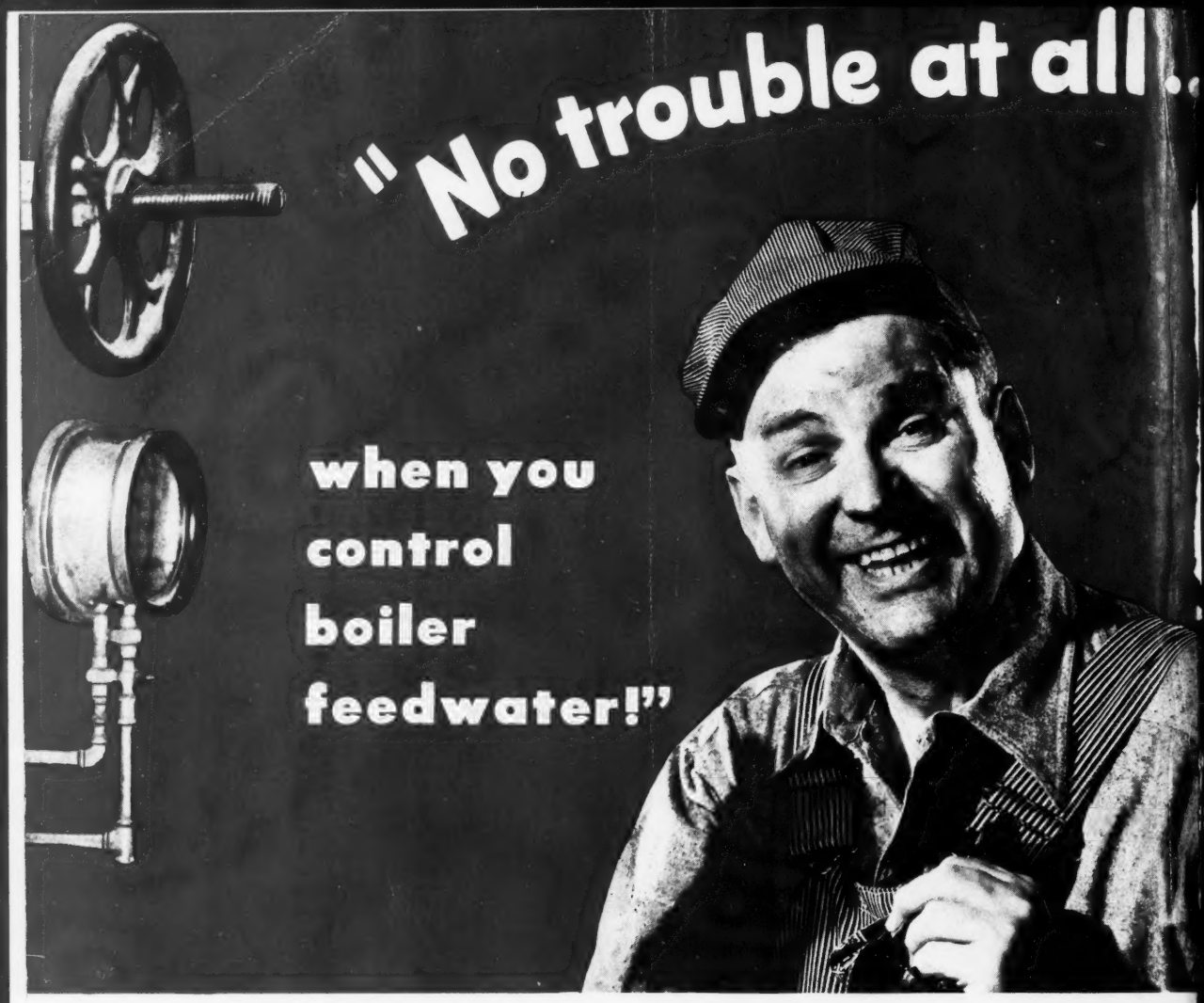

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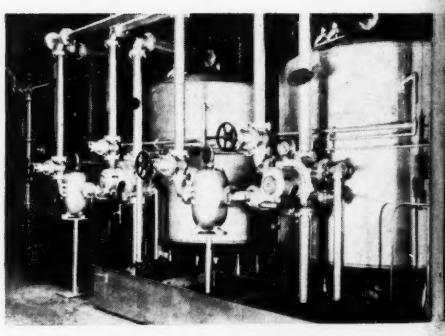

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